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Faculty of Tropical AgriSciences

Adoption of Sustainable Agricultural Practices and their Influence on Food Security in Lagos State, Nigeria

MASTER'S THESIS

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Study Programme: Tropical Farming Systems

Declaration

I hereby declare that I have done this thesis entitled Adoption of Sustainable Agricultural Practices and their influence on Food Security in Lagos State, Nigeria independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 25th April,2024

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Akinkugbe Oluwakemi Funmilayo

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Abbreviations

SAP	Sustainable Agricultural Practices
GMO	Genetically Modified Organisms
FAO	Food and Agricultural Organization
IFAD	International Fund for Agricultural Development
CSA	Climate Smart Agriculture
CA	Conservation Agriculture
IFRI	International Institute for Food Policy Research
FVS	Food Variety Score
DDS	Dietary Diversity Score
DD	Dietary Diversity
DDI	Dietary Diversity Indicators
SDGs	Sustainable Development Goals
WHO	World Health Organization
UNICEF	United Nations International Children's Emergency Fund
SOC	Soil Organic Carbon
GDP	Gross Domestic Product
WFD	World Food Programme
FCS	Food Consumption Score

Abstract

This study examines the factors influencing smallholder farmers' choices to adopt Sustainable Agricultural Practices (SAPs) in Lagos State, Nigeria, focusing on improved seed, fertiliser, soil and water conservation. It examines how this adoption affects agricultural revenue and food security. Household dietary and decreased coping strategy scores are used for evaluating food security. This study is primarily focused on Lagos, a mega-city in Nigeria, due to the obstacles encountered by the farming sector, including land degradation, environmental concerns, poor agricultural output, and poverty.

The socio-economic characteristics of the household examined revealed that 60% of the farmers are males while 40% of them are females. In terms of age, 1.7% of them are less than or equal to 30 years, 22.5% of them are between 31-50 years of age, while the majority (36.7%) of them are between 41-50 years of age. Other socio-economic variables analysed include educational status, household size, farming experience, farm size, and household members working in agriculture. The gender and household size variables were significant suggesting that women are more likely to use sustainable farming practices and larger household size more likely to adopt multiple SAPs.

It was also important to point out that another measure used to analyse the level of food security was the food consumption index. Based on the results it was observed that the majority (48.3%) of the farming households fall within the poor category of dietary consumption, while only 25% of them fall within the acceptable category.

Further research should explore the area of making comparison between previously established traditional farming methods and sustainable agricultural practices, with respect to the income of the farmers and the effect or impact this has on food security. In line with the findings of this research, more work needs to be done on improving the wellbeing and quality of life of members of rural farming households.

Keywords: Sustainable Agricultural Practices (SAPs), Food Security, Dietary Consumption Lagos, Nigeria

1. Introduction

The recommendation to adopt sustainable agriculture practices (SAPs) has been proffered by a multitude of scholars and global organizations as a viable means to confront the multifaceted challenges posed by global warming and food security. The imperative to expand the implementation of SAPs in developing nations, where the simultaneous growth of population and income poses a dire threat to the adaptability of finite resources, has been underscored and emphasised by the global endorsement of the Sustainable Development Goals (Setsoafia, 2022). To effectively address the ever-increasing demand for agricultural products and surmount the myriad of issues stemming from conventional agricultural methods, the Food and Agriculture Organization (FAO) proposes a transition from prevailing agricultural practices to the adoption of Sustainable Agricultural Practices (SAPs) (Pham and Nguyen, 2023). These SAPs encompass a range of innovative approaches and techniques, including but not limited to genetically modified organism (GMO) crops(Zhang et al., 2011), Organic waste management (Pham and Nguyen, 2023), crop rotation (Pham et al., 2021), comprehensive pest control, intercropping, and the utilization of biopesticides (Sharma et al., 2020). The efficacy and effectiveness of SAPs lie in their inherent ability to alleviate ecological predicaments and enhance the overall availability of food resources.

Historically, Nigeria's economy has been heavily reliant on agriculture, despite the country's possession of significant natural gas and oil reserves. Agriculture has been a primary and substantial contributor to Nigeria's Gross Domestic Product (GDP) until relatively recently (Hamadina and Hamadina, 2015). By embracing sustainable farming techniques, Nigeria has the potential to significantly bolster the environmental sustainability of its agricultural practices by diminishing the requirements for inputs and minimizing the generation of waste associated with the utilization of said resources (Mwalupaso et al., 2019). The employment and application of sustainable agricultural methods are not only crucial but also imperative for ensuring the attainment of food security, stimulating rural employment and income, and fostering growth in specific agricultural sectors. Recent studies conducted by (Manda et al., 2016), (Manda et al., 2016; Murendo et al., 2016; Teklewold et al., 2013a), have conclusively demonstrated that the utilization of SAPs leads to higher economic yields. However, despite the undeniable benefits of SAPs, it has been observed that sub-Saharan Africa, as reported by Kassie et al., (2013) and Teklewold et al., (2013), continues to exhibit alarmingly low rates of acceptance and implementation of Structural Adjustment Programmes (SAPs). It is of utmost importance to possess a comprehensive and holistic understanding of the myriad of factors that impact the adoption of SAPs, as this understanding may aid in the identification of key motivators and areas for further enhancing the implementation of these sustainable strategies. Regrettably, previous studies conducted by Arslan et al., (2014) and Ghimire et al., (2015) failed to adequately elucidate and incorporate the various trade-offs and synergies associated with the utilization of SAPs, instead focusing solely on individual systems.

Insufficient agricultural productivity in Nigeria, resulting from the adoption of unsustainable farming practices, emerges as a significant contributor to the prevailing issue of food insecurity within the country (Umeh and Igwe, 2019). According to Irepi (1995), the poor agricultural productivity observed in Nigeria can be attributed to the farmers' limited knowledge and their reluctance to embrace soil-assistance programmes (SAPs), which have been proven to effectively enhance soil quality and bolster agricultural yields. In terms of the overall benefits in the agricultural sector, the long-term implementation of Structural Adjustment Programmes (SAPs) has been found to play a pivotal role in reducing hunger levels, alleviating severe poverty, and enhancing agricultural efficiency. Sustainable agriculture, as a holistic approach, takes into account not only the financial gains that producers derive from their farming endeavours but also the preservation of the environment. Therefore, the development and promotion of sustainable agricultural production are deemed to be both crucial and invaluable. Despite the substantial advantages offered by SAPs, their adoption remains relatively limited (Umeh and Igwe, 2019). Nigeria's primary agricultural challenge revolves around the dual objective of providing sufficient food for its expanding population and effectively addressing the prevailing political, economic, and cultural hurdles. Unfortunately, there is presently a dearth of information about the progress made in the field of sustainable agriculture. Conducting an in-depth examination of the rate at which SAPs are being embraced may catalyse heightened awareness, as suggested by Umeh and Igwe (2019). It is worth noting that agricultural practices are both contributors to and victims of climate change, thereby exposing the agricultural industry to heightened risks. Approximately 17% of global greenhouse gas emissions can be attributed to agricultural activities, significantly influencing climate change on a global scale (Lynch et al., 2021). The primary sources of these emissions encompass the release of methane resulting from biological processes, the emission of nitrous oxide due to soil management techniques, the combustion of fossil fuels leading to the emission of carbon dioxide, and alterations in land utilization (Cloy & Smith, 2018). Furthermore, the ramifications of global warming contribute to exacerbating the vulnerability experienced within the agricultural sector. Elevated temperatures have the potential to impede the productivity of vital crops, while alterations in precipitation patterns amplify the likelihood of crop failures and diminish long-term agricultural output (Lynch et al., 2021). Climate change also facilitates the rapid proliferation of pests and plant diseases. The escalating temperatures and increased rainfall engender conditions that are conducive to the development and spread of parasitic organisms. The utilization of pesticides, fertilizers, and other hazardous agricultural chemicals as a means of controlling pests and illnesses may inadvertently result in the contamination of freshwater and marine ecosystems, while simultaneously compromising air quality and soil health (Sen et al., 2021).

This research examines the factors influencing smallholder farmers' choices to adopt Sustainable Agricultural Practices (SAPs) in Nigeria, focusing on improved seed, fertiliser, and soil and water conservation. It examines how this adoption affects agricultural revenue and food security. Household dietary and decreased coping strategy scores are used for evaluating food security. This study is primarily focused on Lagos, a mega-city in Nigeria, due to the obstacles encountered by the farming sector, including land degradation, environmental concerns, poor agricultural output, and poverty. Therefore, there is a need to use sustainable farming techniques in order to raise awareness on the topic. Sustainable agriculture practices (SAP) provide a potential solution to the dilemma of balancing increased food production with reduced environmental impact, as highlighted by (Runhaar, 2016).

2. Literature Review

2.1 Sustainable Agriculture

Sustainable agriculture encompasses the integration of natural processes, such as nutrient cycles and nitrogen fixation, into agricultural practices. This integration aims to reduce the reliance on harmful external and non-renewable inputs that have the potential to disrupt ecosystems and affect both farmers and consumers. By considering the interactions between pests and predators, sustainable agriculture seeks to address these issues in a holistic manner. The involvement of farmers and rural individuals is crucial in the analysis of problems, development of technology, adaptation and extension of practices, as well as the monitoring and evaluation of outcomes. Furthermore, it emphasizes the importance of ensuring fair access to productive resources and opportunities, to enhance the effective utilization of local knowledge, practices, and resources. In addition, sustainable agriculture emphasizes the incorporation of a variety of natural resources and enterprises on farms, with the aim of promoting self-sufficiency among farmers and rural communities (Pretty et al., 1996). The overarching goal of sustainable agriculture is to benefit both people and the environment by promoting harmonious coexistence and optimizing the use of resources. According to (Moradabadi et al., 2020), achieving sustainability in agriculture requires a balanced consideration of economic reasoning and ecological sufficiency. Therefore, agricultural systems must encompass multiple dimensions of sustainability to comprehensively evaluate their sustainability. It is essential to conduct thorough assessments of the sustainability of agricultural systems, taking into account various factors and indicators.

Sustainable agricultural production involves the strategic management and utilization of agricultural ecosystems in order to preserve biodiversity, productivity, reproductive capacity, vitality, and functional capability. This approach aims to achieve significant economic and social objectives, while also ensuring the long-term preservation of diverse ecosystems (Asaba, 2006). One of the primary objectives is to assist farmers in generating consistent and substantial earnings, thus contributing to poverty reduction (Umeh and Igwe, 2019). The Food and Agriculture Organization (FAO) defines sustainable agriculture as the meticulous management and conservation of natural resources through institutional and technical advancements, with the aim of meeting both current and future human needs. This alternative approach to agriculture guarantees sustainability from multiple perspectives. With the increasing global population and decreasing availability of arable land in many countries, the practice of continuous agriculture is replacing the traditional practice of leaving land fallow in many regions. However, this shift has led to poverty, decreased production, and land degradation. Therefore, the utilization of agricultural technology to enhance productivity has become not only essential but perhaps the only viable solution for improving agricultural output. The urgent need to address land degradation, poor agricultural production, and poverty in Sub-Saharan Africa has resulted in the growing importance of implementing sustainable agricultural practices (SAPs) as part of development policies (Ajayi, 2007; Teklewold et al., 2013a).

Sustainable agricultural practices can address a wide array of impediments, encompassing agricultural concerns such as inadequate growth in productivity, in addition to environmental predicaments like the deterioration of soil and the scarcity of water. Nevertheless, the examination of the economic advantages that farmers can obtain from the utilization of sustainable agricultural practices is still a topic that is being debated. The impact of embracing sustainable agricultural practices is contingent upon various factors, such as the scale of agricultural activities and the multifaceted nature of agricultural, ecological, and socio-economic issues. The provision of concrete data regarding the effects stemming from the adoption of sustainable agricultural practices may serve as a source of motivation for farmers to accept this solution, while simultaneously aiding policymakers in the formulation of effective methodologies to encourage its adoption. Previous investigations pertaining to the implementation of Structural Adjustment Programmes have classified them into multiple categories based on their impact on the economy, employment, poverty rates, as well as outcomes in the realms of education and health (Pham and Nguyen, 2023). There exists a dearth of studies that explore the repercussions of sustainable agricultural practices adoption on labour and land productivity, as well as total productivity. The estimation of land productivity has been a recurring issue in previous research. Given sustainable agricultural practices' application in the agricultural sector, it is imperative to concentrate on the evaluation of the impact on agricultural income. Numerous studies employ family income per capita as a metric for quantifying the economic ramifications that arise from the implementation of sustainable agricultural practices, as indicated by Pham and Nguyen in 2023. Research conducted by (Kassie et al., 2015; Manda et al., 2016; Teklewold et al., 2013a) divulges that the utilization of a combination of sustainable agricultural practices packages yields greater benefits in terms of household income and the alleviation of poverty when compared to the employment of solitary sustainable agricultural practices. Nonetheless, there is a paucity of research about the overall effect resulting from the adoption of sustainable agricultural practices across both single and multiple packages. Despite concerted endeavours by national and international organizations to encourage farmers residing in rural areas of developing nations to invest in sustainable agricultural practices technology, the rate of adoption remains relatively low. Despite significant endeavours to promote diverse solutions aimed at soil and water conservation, as well as the acceleration of erosion, the degradation of soil continues to constitute a pivotal impediment to development and the sustainable intensification of production in Nigeria. Grasping the obstacles that impinge upon the attitudes of farmers concerning innovative approaches is indispensable for the formulation of effective policies that bolster support for the underprivileged and augment output.

2.1.1 Climate change's impact on promoting sustainable agriculture practices

Most farmers in low-income economies heavily rely on rain-fed subsistence farming as their primary source of income and livelihood (Charles et al., 2014). Their dependence on the natural resource base, such as land and water, is also significant (Debela et al., 2015). The productivity of these farmers greatly depends on favourable seasonal weather conditions and other unpredictable natural factors, such as rainfall patterns and temperature fluctuations (Solomon et al. 2007). These factors play a crucial role in determining the success or failure of their agricultural activities. However, due to the increasing impact of climate change, the vulnerability of these farmers to its adverse effects has significantly increased (Antwi-Agyei et al., 2012; Debela et al., 2015). As a result, there are potential consequences for agricultural production, which can have severe implications for their livelihoods and overall well-being. Studies have estimated that there could be a decline of 15-30% in agricultural productivity in most Sub-Saharan African and South Asian regions (Charles et al., 2014a).

This decline is particularly concerning for socioeconomically underdeveloped regions, especially when their economies are heavily reliant on the natural resource base and climate-sensitive sectors, such as agriculture, water, and forestry (Sinha et al., n.d.). In such regions, the impacts of climate change are expected to be more severe compared to other regions, as they lack the necessary resources and infrastructure to adapt effectively to these changes. Furthermore, countries with agricultural-based economies, in particular, are likely to face greater challenges due to climate change (Debela et al., 2015; Hanjra and Qureshi, 2010). These countries often have limited capital resources and face difficulties in enhancing their adaptation capacities (Antwi-Agyei et al., 2012). Consequently, they are more vulnerable to the adverse effects of climate change on their agricultural systems and overall food security. Climate change affects agriculture by altering the spatial and temporal distribution of rainfall, which directly influences the availability of water for irrigation and crop growth (Mbow et al., 2014). The changes in rainfall patterns can lead to droughts or floods, both of which can have detrimental effects on agricultural productivity and the livelihoods of farmers. Overall, the impacts of climate change on agriculture are multifaceted and interconnected, affecting various aspects of the farming system, such as crop yields, water availability, and overall sustainability.

2.1.2 Methods for implementing SAPs

Long-term food security is a matter of utmost importance that necessitates immediate attention and action in the form of adopting and implementing innovative ideas and practices for sustainable agriculture across all levels of agricultural production (Muhie, 2022). When formulating strategies to ensure the sustainability of agricultural practices, careful consideration is often given to the requirements and demands of the entire farm or system. These strategies are flexible and adaptable, capable of being tailored to suit varying conditions and production methodologies. It is imperative to note that these strategies are expert-driven, with the involvement of specialists who possess the necessary knowledge and expertise. In certain instances, the establishment of labels or markets, such as in the case of organic farming, may already be in place, further reinforcing the significance of these strategies. Regardless of the specific approach chosen, whether it be permaculture, high-value agriculture, sustainable intensification, or another method, it is crucial to acknowledge and appreciate the fact that the decisions made by farm owners have far-reaching and long-lasting consequences on their overall management practices (Muhie, 2022).

2.1.3 Climate-smart agriculture

Climate change is presenting an increasingly substantial and escalating danger to the global realm of food and nutrition security. In many regions of the developing world, the expansion of the population and the upward trend in wages have propelled the demand for sustainable food security to imbalanced levels (Muhie, 2022). Climate Smart Agriculture (CSA) embodies an approach aimed at augmenting the management of agriculture during the era of climate change to achieve sustainability. It encompasses a strategy for the introduction of novel agricultural technologies and practices to elevate production, adaptability, and the ability to mitigate climate change (Branca et al., 2011; Zilberman et al., n.d.).CSA represents a relatively recent strategy that assists marginalized individuals in enhancing agricultural production and revenue by guaranteeing the implementation of superior agricultural practices, while simultaneously reducing greenhouse gas emissions (Muhie, 2022). The CSA strategy was established as a response to the current issues in climate change and the execution of agriculture policies for sustainable agriculture (Muhie, 2022). CSA pertains to agricultural methodologies that possess the capacity to amplify production, enhance resilience (adaptation), and mitigate greenhouse gas emissions (mitigation), all the while aiding in the attainment of food security and developmental endeavours (productivity) (Muhie, 2022). The concept of CSA also necessitates the achievement of three primary objectives: sustainably boosting food security through amplified production and incomes, fostering resilience and adapting to climate change, and reducing greenhouse gas emissions when compared to a business as usual or baseline scenario (Wiebe et al., 2018). The approach of climate-smart agriculture has consistently acknowledged the potential for trade-offs among the three aforementioned objectives, as well as the capacity to enhance efficiencies among them through the implementation of policies, institutions, and financing (Branca et al., 2011; Muhie, 2022).

2.1.4 Organic agriculture

Organic farming places a strong emphasis on the protection of the environment, the welfare of animals, the quality and safety of food, the sustainability of resources, and the pursuit of social justice. Furthermore, it utilizes the market as a means to sustain these aims and offset the internalized consequences that may arise (Dhiman, 2020). According to a modern definition of organic farming provided by an authoritative source (Muhie, 2022) the ultimate objective is to establish integrated, humane, environmentally and economically sustainable production systems. These systems are designed to maximize reliance on farm-derived renewable resources and effectively manage ecological and biological processes and interactions. The goal is to ensure acceptable levels of crop, livestock, and human nutrition, as well as protection from pests and diseases, while providing a suitable return to human and other resources (Dhiman, 2020; Gomiero, 2016). This comprehensive approach, outlined by (Muhie, 2022), encompasses various aspects of organic farming that contribute to its efficacy and potential. For instance, this agricultural practice consistently yields satisfactory results, improves soil health, avoids any adverse environmental impact, produces organic food, and reduces the need for synthetic fertilizers. Consequently, organic farming stands as a scientifically proven, environmentally benign method for upholding ecological integrity (Muhie, 2022).Moreover, organic farming has emerged as a viable and sustainable approach to agriculture, particularly relevant for small farmers in rural areas, particularly those in developing countries. It has the capacity to enhance soil and ecosystem health, while remaining self-sustaining through the reduction in chemical fertilizer and pesticide usage and the recycling of agricultural waste. As individuals become increasingly aware of their health and concerns regarding the quality of food and the environment, organic agriculture is gaining popularity (Muhie, 2022).

2.1.5 Biodynamic Agriculture

Biodynamic farming, which can be considered as either the precursor or a subset of organic farming, shares numerous similarities with organic agriculture. These similarities include the utilization of natural fertilizers and the avoidance of conventional herbicides, insecticides, and fungicides. However, the primary distinguishing factor between biodynamic and organic farming lies in the consideration of natural rhythms by biodynamics. In the case of biodynamic farming, producers meticulously analyse the movements of the sun and moon to determine the most opportune moments for cultivating and harvesting various plants, flowers, and edibles. This meticulousness is essential in order to ensure that these agricultural products possess their utmost attributes (Muhie, 2022). Due to the significant role that mysticism plays in biodynamic agriculture, practitioners of this farming method possess a heightened awareness of the enigmatic and imperceptible forces at play in nature. This awareness extends from the impact of solar and lunar movements to the intricate interconnectedness of all entities existing beneath and above the surface of the soil (Beluhova-Uzunova and Atanasov, 2019; Paull and Hennig, 2020). Both organic and biodynamic farming share the common characteristics of being devoid of chemicals and genetically modified organisms (GMOs). Nevertheless, biodynamics takes a step further by adopting a holistic approach that scrutinizes all interconnected living systems, which encompass animals, plants, and the entire universe. Through the replenishment of the soil and the restoration of vitality to plants and/or livestock, biodynamic practices actively contribute to the cultivation of superior crops and the healing of the planet (Muhie, 2022).

2.1.6 Sustainable intensification

Sustainable intensification (SI) is a method that increases agricultural output and productivity without harming the environment or requiring the conversion of additional non-agricultural land (Pretty and Bharucha, 2014). The phrases 'sustainable' and 'intensification' are used together to indicate that various ways may be used to accomplish desired objectives related to increased food production and enhanced environmental benefits (Muhie, 2022). Sustainable intensification involves merging and creating synergy among current individual solutions, with an emphasis on qualities that address a range of social challenges (Mbow et al., 2014; Weltin et al., 2018). Recently, green revolution methods have established industrial systems focused on increasing productivity. The policies were originally intended to broaden markets and provide farmers with more chances to enhance their income and social status. Environmental measures are gaining popularity in recent years (Muhie, 2022). Production systems that can address many social issues effectively are likely to have a bright future, as shown by several studies (Charles et al., n.d.; Pretty et al., 2018). The new solutions' additional value is in determining the optimal configuration of components to accomplish this objective (Pretty et al., 2018).

2.1.7 Regenerative Agriculture

Regenerative agriculture is a food and agricultural system focused on preserving and restoring the land. The focus is on regenerating topsoil, enhancing biodiversity, improving the water cycle, supporting ecosystem goods and services, promoting bio-sequestration, enhancing climate change resilience, and maintaining agricultural soil health and vitality (Keesstra et al., 2018). Regenerative agriculture is being advocated as a possible alternative approach to food production that might have reduced or even positive environmental and social effects (Rhodes, 2017). Regenerative agriculture aims to enhance soil health or restore severely damaged soil, leading to improved water quality, vegetation, and land productivity (Muhie, 2022). Increasing soil organic carbon (SOC) in current soils may be achieved using regenerative agricultural technology (Lal, 2006; Rhodes, 2017). Additionally, it is possible to create new soil. This decreases carbon emissions and enhances soil structure, health, fertility, crop yields, water retention, and aquifer replenishment, and helps prevent floods, droughts, and soil degradation from reduced runoff (Power, 2010).

2.1.8 The Difficulty and Need of SAPs

The agricultural industry is facing immense pressure to meet the demands of a rapidly expanding global population, which is projected to reach a staggering 9.2 billion individuals by the year 2050. This trend is evident in the increasing need for essential commodities such as food, industrial raw materials, and biofuels (Nchanji et al., 2017; Pretty and Bharucha, 2014). Africa, due to its proximity to the equator, is particularly susceptible to the impacts of climate change (Abdulai, 2018). Climate change in this region manifests in rising sea levels, and alterations in temperature and rainfall patterns, all of which have detrimental effects on agricultural production, farm income, food security, and overall economic growth. It is important to emphasize that individuals living in poverty in Sub-Saharan Africa heavily rely on agriculture as their primary source of livelihood when they lack access to sufficient food. Recognizing the significance of this sector, numerous international organizations consider agriculture as a critical approach to addressing food insecurity and poverty in the region (Leonardo et al., 2018).

Experts argue that tackling this challenge can be accomplished through the widespread implementation of sustainable agricultural management practices (Pretty and Bharucha, 2014); To mitigate the adverse effects of crop intensification, farmers are advised to adopt sustainable agriculture techniques that integrate elements of both green revolution and an agronomic revolution. These techniques have been categorized into distinct typologies by various scholars, which can be utilized interchangeably. Some scholars prefer to use the term sustainable intensification practices (SIPs) to describe these techniques (Kassie et al., 2013a; Kotu et al., 2017), while others refer to them as sustainable agriculture practices (SAPs) (Gebremariam, 2016a; Kassie et al., 2013a; Teklewold et al., 2013a).

2.1.9 Implementation of SAP in Africa and Nigeria

Worldwide, but especially in Africa's small-scale agriculture, the Structural Adjustment Programme is crucial. Various challenges affect the agricultural sector, including poor soil quality, insufficient infrastructure, climate change, unfavourable market conditions, loss of agricultural biodiversity, inefficiency, and increasing productivity. These issues also contribute to challenges such as low agricultural income and food insecurity (Armah et al., 2013; Teklewold et al., 2013a). The original SAP idea being introduced in an African setting is not surprising due to the poor agricultural productivity and reported depletion of natural resources in Africa at that time.

The decrease of arable land in Lagos and other Nigerian cities is due to fast urbanisation and population increase. This compels farmers to engage in continual cultivation of their fields, instead of adhering to conventional methods of allowing them to lay fallow for extended periods. Consequently, agricultural production has declined as land degradation has risen. Agricultural production without sustainable farming techniques worsens poverty and food insecurity. The outcomes stem from decreased land productivity, resulting in less agricultural revenue and a decreased food supply to families. The fast urban growth is a significant risk to the sustainable progress of agriculture in Nigeria. This is because land is a finite resource that has to be allocated for both agricultural and urban uses. Urbanisation is rapidly increasing according to (Adedokun et al., 2018; Teklewold et al., 2013b). Implementing sustainable agriculture involves using various agricultural methods such as agroforestry, biological pest management, crop rotation, composting, intercropping, mulching, and water harvesting. It also involves using environmentally friendly fertilisers. These techniques are quite suitable in the setting of

Lagos. In the Savannah Region of northern Nigeria, rotational farming is most suitable for small-scale farms because of the prevalence of urbanisation, which hinders the consideration of minimalism and other techniques. These strategies are advantageous since they enhance productivity, a crucial factor for fostering economic growth (Adedokun et al., 2018).

2.1.10 Factors influencing the implementation of SAP

Several research have investigated the variables influencing the adoption of SAPs in Africa. Previous studies have mostly concentrated on individual elements of SAPs (Abdulai and Huffman, n.d.; Adenle et al., 2019; Carrión Yaguana et al., 2016; Kimathi et al., 2021; Manda et al., 2020; Martey et al., 2020; S., 2022). (Abdulai and Huffman, n.d.)found that rice farmers' choices to use soil and water conservation practices are impacted by factors such as education level, financial resources, labour limitations, social connections, extension services, and soil conditions on their farms. Manda et al. (2018) discovered that the adoption of enhanced maize varieties by farmers in Zambia is mostly affected by factors such as education, family size, livestock ownership, land availability per person, access to market information, and geographical location. (Martey et al., 2020)found that farmers in Ghana primarily base their decision to adopt drought-tolerant maize varieties on factors such as seed availability, gender, access to extension services, labour availability, and geographical location. (Kimathi et al., 2021)studied the variables influencing farmers' choice to use climate-resilient potato varieties. They identified access to information, quality seeds, training, group participation, and differences in agro-ecological zones as the primary factors determining adoption.

Several studies have examined the various variables influencing small-scale farmers' choices to implement several Sustainable Agricultural Practices (SAPs). Previous studies have mostly concentrated on Eastern and Southern Africa (Kassie et al., 2015; Teklewold et al., 2013a). A significant amount of study has been conducted to address the lack of information on various SAPs applied in West Africa by (Ehiakpor et al., 2021; Nkegbe and Shankar, 2014; Struik et al., 2014). (Teklewold et al., 2013a) examined several Sustainable Agricultural Practices (SAPs) such as seed improvement, inorganic fertiliser use, animal manure utilisation, conservation tillage, and maize and grazing field rotation. The study found that the primary factors affecting the probability and extent of SAP adoption in rural Ethiopia include labour availability, infrastructure, market accessibility, rainfall patterns, credit constraints, spouses' educational levels, household wealth, social capital, networks, and government support availability. Ehiakpor et al (2021)investigated several Sustainable Agricultural Practices (SAPs) in their research on Ghana, including enhancements in maize seeds, maize and lime rotation, animal-based fertilisers, legume intercropping, crop waste retention, restricted tillage, integrated pest management, and chemical fertilisers. Various factors such as non-agricultural income, ownership of livestock, the prevalence of pests and diseases, experience with soil erosion, farmers' perceptions of low soil fertility, field demonstration participation, membership in savings groups, access to agricultural credit, land ownership, and proximity to markets for agricultural inputs significantly influenced the adoption of SAPs (Ehiakpor et al., 2021).

2.2 Food Security

Global food security is a major problem, but the difficulties related to food security are becoming more urgent due to the worsening effects of climate change on food production. In 2020, reports from FAO, IFAD, UNICEF, the World Food Programme, and WHO indicated that 2.8 billion people out of the total 7.8 billion worldwide, mainly in Asia and Africa, experience different levels of food insecurity, from moderate to severe. Within this demographic, 250,000 persons in Africa are classed as undernourished. In addition, the study results highlight Africa as the location with the greatest occurrence of nutritional ossification worldwide (Setsoafia, 2022). The challenges in Sub-Saharan Africa (SSA) have worsened due to heavy dependence on agriculture, which is impacted by rainfall patterns, food supply variations, and insufficient management of natural resources in the area (Adamu et al., 2021; S., 2022; Huss et al., 2021). The issue may be attributed to rapid population expansion, changes in climatic patterns, and widespread poverty in certain regions (Adeyeye et al., 2023; Atosina Akuriba et al., 2021; Maja and Ayano, 2021). Food security and food insecurity refer to the availability of sufficient and healthy food for a population. Food security involves several aspects such as food availability, access, utilisation, and sustainability (FAO, 2017). Hence, individuals may be seen as having access to safe food if they are able to regularly get suitable, safe, and nourishing food all year round. While food insecurity is more prevalent in poor nations, it is a significant concern for both developing and developed countries (Mohammed et al., 2021). Household food insecurity is a major factor in malnutrition and mortality in poor countries, emphasising the significance of addressing food security within the Sustainable Development Goals (SDGs). Empirical research indicates a strong connection between food insecurity and socioeconomic characteristics such as poverty, low income, job status, age, family size, and educational level (Drammeh et al., 2019; Fikire and Zegeye, 2022); (Mohammed et al., 2021). Higher education has been shown to potentially result in increased food security (Mohammed et al., 2021).

Food security refers to the consistent provision of sufficient, safe, and nourishing food to fulfil the nutritional requirements and choices of persons for a healthy and energetic lifestyle (Food and Agricultural Organisation, 1996). The concept highlights several aspects of food security, such as sustainability, utilisation, supply, and access. Accessibility refers to the ability to get food efficiently as required, whereas access is the tangible availability of an adequate quantity of food. Sustainability ensures a continuous food supply, whereas utilisation pertains to the need for adequate quantities and quality of food intake. Several indicators of individual food security have been identified in several studies (Lokosang et al., 2011; Obayelu, 2012; Pangaribowo et al., 2013; Yu and You, 2013). Various indicators for food insecurity include consumption share, coping mechanism index, diversity/food consumption scores, anthropometry measurements, self-report/evaluation scales, intake share, and per capita food consumption and expenditure. The issue in the literature revolves on whether a single measure can effectively capture the many aspects of established food security (Ogundari, 2017). Unfortunately, there is no comprehensive indicator that covers all aspects of food security (Hoddinott, 1999). Various metrics and indicators need to be combined to address the complex nature of food insecurity in a given circumstance (Carletto et al., 2013). Habicht et al (n.d.)argue that no indication is fundamentally superior to others since the quality of an indicator might be considered "good" depending on the specific criteria used.

2.2.1 Food Security metrics

In developing countries, people working in agriculture in rural areas confront severe poverty and struggle to meet their basic nutritional needs daily (Akukwe, 2020). Nigeria is classified as one of the 55 countries with low-income food deficiency due to the high number of children living in agricultural households. Various methods are used to measure global food safety, including per capita food expenditure, food insecurity access scale, food consumption index, per capita food consumption, proportion of food intake, and coping strategy index. Despite thorough research on food security indicators, there is still no agreement on the crucial factors needed to accurately evaluate the status of families globally at both small and large scales (Akukwe,2020). Issues contributing to food insecurity may be categorised into social, economic, environmental, political, and physical issues. Various reasons, including drought, land degradation, population expansion, lack of productive resources, inadequate assets, poverty, and other issues, have been studied to understand the rise in food insecurity across various nations (Fikire and Zegeye, 2022). dietary insecurity is a constant hazard to public health and must be considered to reduce environmental risks, tackle malnutrition and dietary variety issues, and treat psychological concerns (Drammeh et al., 2019). Extensive study is being carried out globally to investigate the elements that influence food security, such as socioeconomic, institutional, environmental, and safety-related concerns. Cheema and Abbas (n.d.)discussed the beneficial effect of non-farm revenues on family food security, whereas (Thapa Karki et al., 2021)underscored the significance of property ownership as a factor influencing food security. Similarly, Firdaus et al (2020) established a correlation between household food security and socioeconomic factors including family size, land size, and land quality. Emphasised the significance of age in the food security index.

2.2.2 Food consumption

The need for agricultural goods on a global scale is expanding and is expected to experience a rise in the coming years. This surge can be attributed to the ever-increasing worldwide population, which is projected to grow by a staggering 2.3 billion individuals, as well as an anticipated increase in per capita incomes until the midpoint of the century, as highlighted by (Charles et al., 2014b). It is crucial to note that agriculture plays a significant role in shaping the global ecosystem, primarily through activities such as land clearance and habitat fragmentation, which in turn pose a significant danger to biodiversity. This assertion is supported by the research conducted by (Dirzo and Raven, 2003). While the expansion of agriculture through the clearance of areas and the improvement of existing croplands may contribute to meeting the escalating need for food production, we must acknowledge that the environmental impacts and potential trade-offs associated with these methods are still largely unknown and require further investigation, as emphasized by (Charles et al., n.d.). At present, the world is grappling with a triple challenge, as eloquently outlined by (Dhanarajan, 2017). This challenge involves aligning food demand with a growing and wealthier population, ensuring sustainable provision of food for the environment and society, and most importantly, guaranteeing that the most impoverished individuals across the globe are not subjected to the horrors of hunger.

2.2.1 Dietary Diversity Indicators

Diet diversity indicators (DDIs) are considered promising measures for use in poor countries due to their simplicity and potential for widespread use, in contrast to other food consumption indicators that need intricate quantitative data gathering (Verger et al., 2021). Recent studies have identified many dietary diversity indicators, including Dietary Diversity Scores (DDS) and Food Variety Scores (FVS). DDS relies on food categories, which are more effective than indicators based on single foods (e.g., FVS) for predicting nutritional adequacy, however, the composition of food groups may fluctuate among studies (Zhao et al., 2017). Dietary Diversity (DD) refers to the variety of dietary categories or individual items ingested during a certain timeframe, as described by (Weerasekara et al., 2020).DD is a crucial metric for sustainable diets and is being evaluated as a primary indicator for the United Nations' Sustainable Development Goals (SDGs).

Studying dietary variety may help assess insufficient micronutrient intake, family food security, sustainable dietary habits, and changes in eating patterns (Luckett et a., 2015). The Dietary Diversity Score (DDS) is the count of food groups consumed within a 24-hour period. The diet was categorised into nine food groups based on FAO recommendations: 1) cereals, roots, and tubers; 2) vitamin-A-rich fruits and vegetables;

3) other fruit; 4) other vegetables; 5) legumes and nuts; 6) meat, poultry, and fish; 7) fats and oils; 8) dairy; and 9) eggs. Tea, sugar, and sweets were excluded from the computations for the Dietary Diversity Score (DDS) and Food Variety Score (FVS). The Food Variety Score (FVS) is the count of food items eaten throughout a 24-hour period out of a potential total of 45 items (Haltoy, 1998). The Dietary Diversity Score (DDS) indicates that families find happiness in the food they eat due to the principle that diversity enhances enjoyment, as opposed to just more quantity being better. According to USDA-ERS (2012), a greater Dietary Diversity Score (DDS) indicates that a family is eating a varied diet that provides adequate micronutrients. An increase in wealth generally leads to a family transitioning from a limited diet to a more varied one. Household meat consumption tends to rise with increased wealth. DDS reflects the food utilisation aspect of food security (Nchanji et al., 2017; Ogundari, 2017).

2.3 Implications of Sustainable Agriculture

Sustainable agriculture is linked to food security, which encompasses the availability of food, access to food, nutritional adequacy, safety, and the economic stability of these conditions.

Prior research has highlighted the contradictory results in the literature about the impacts of sustainable agricultural practices (SAPs). Several studies have demonstrated the positive effects of Sustainable Agricultural Practices (SAP) (Kassie et al., 2018a; Mgomezulu et al., 2018; Teklewold et al., 2013c; Zeweld et al., 2021), but (McCarthy et al., 2021)argue that specific SAPs, such as moss removal and soil erosion, do not significantly enhance crop yields and, therefore, do not enhance food security. In addition, the 2017 research conducted revealed that some Sustainable Agricultural Practices (SAPs), such as using stone bread, resulted in a significant decrease in crop yields. This loss negatively impacted farmers' ability to ensure food security and generate income from selling excess agricultural goods. Other academics have raised doubts about the practicality of these activities since they have not recognised that these methods have been either discontinued or implemented inconsistently in various agricultural and climatic settings. For instance, research was undertaken by Bell et al. (2018) at the International Institute for Food Policy Research (IFPRI). The article from 2018 recognises the common use and discontinuation of conservation agriculture (CA). It highlights that farmers find it challenging to sustain this practice long-term because of labour-intensive activities like manual weeding, digging holes for pit planting, and acquiring enough straw for mulching. Moreover, the use of herbicides for weed control raises the expenses linked to Conservation Agriculture. The variations in adopting these laws hinder the achievement of lasting benefits, resulting in higher yearly food aid needs, increased poverty, and food insecurity. Recent research has raised doubts about the efficacy of sustainable agricultural practices (SAPs), suggesting that while those who adopt them may experience more happiness compared to non-adopters, SAP adoption does not completely counteract the adverse impacts of climate change pressure (Bazzana et al., 2021; Kassie et al., 2018b; Tesfaye and Tirivayi, 2020).

The research utilised multiple outcome variables to assess the effects of SAP, such as household income, agricultural chemical usage, labour requirements, crop productivity, and food stability (Abdulai and Huffman, n.d.; Gebremariam, 2016b; Kassie et al., 2018a; Manda et al., 2016; Teklewold et al., 2013b). A study conducted in Ghana by (Gebremariam, 2016c) revealed that an increased SAP combination resulted in greater net crop revenue and consumer spending. Research conducted by Khonje et al. (2018) in Zambia demonstrates that the simultaneous adoption of numerous Sustainable Agricultural Practices (SAPs) has a notable effect on productivity, family income, and poverty reduction when compared to adopting the individual components of the technology package. Amondo et al. (2019) reported a 15% improvement in maize production in Zambia due to the use of drought-tolerant maize cultivars. Matsuhisa and his colleagues (2020) found that the rise in the adoption of Sustainable Agricultural Practices (SAPs) in Ethiopia led to increased maize yields and revenues.

Several empirical research across various nations have shown the need for sustainable agriculture to enhance food and nutrition security, with the former being able to bolster the latter. (Chowdhury et al., 2017)suggest that policies targeting food security should include strategies to tackle major global sustainability issues at the international, national, and local levels. Skaf et al. argue that sustainable management of agricultural output allows for the provision of healthy, wholesome, and nutritious food for the expanding population. Sustainability should be included in the long-term temporal dimension when evaluating food security, as shown by another research (Skaf et al., 2019). Another research group asserts that the connections between food sustainability and food and nutrition security interact at several levels including global, national, local, and household levels (Berry et al., 2015). Sustainable agricultural and food systems promote food security. (Nkomoki et al., 2018)shown that although the implementation of crop diversity and agroforestry as sustainability measures is linked to increased household food security, other measures such as intercropping and planting basins do not show a significant association with food security. While theoretical studies highlight the benefits of following sustainable agriculture principles on food security, we are confronted with a dilemma: balancing increased food production for security with sustainable farming practices. Sustainable agriculture, without enough assistance, may initially decrease productivity, thereby diminishing farmers' incentive to adopt sustainable methods (Sahraei, 2022).

3 Aims of the Thesis

This research seeks to examine the variables influencing the adoption of SAPs and their effects on farm revenue and food security. The data for this inquiry were acquired from available sources in Lagos, Nigeria. The research adds to the current literature in two primary ways. The study offers practical observations on the significance of SAP concerning social indices, particularly concerning food security. In Nigeria, where farming is mostly subsistence-based and farmers sell their harvests for monetary reasons, food security is a crucial indicator of well-being. As a result, farmers may achieve food security without necessarily having large net farm income or engaging in considerable consumer spending.

This thesis examines enhanced sustainable agricultural practices in Lagos State, Nigeria, and juxtaposes them with traditional approaches. Studying the factors influencing food security is also an objective. We analysed key agricultural practices in the region to establish ideas on the advantages of using sustainable ways to enhance food output and ensure lasting food security. This research project aims to enhance stakeholders' and policymakers' understanding of Lagos State's agricultural environment by providing valuable insights.

3.1 Hypothesis

Hypothesis 1: There is no substantial difference between conventional agricultural operations and improved sustainable agriculture practices in Lagos State, Nigeria. Hypothesis 2 states that there is no substantial difference in the long-term food security improvement between sustainable agricultural approaches (e.g., organic farming, agroforestry, conservation agriculture, integrated pest control) and conventional practices in Lagos State.
Hypothesis 3: There is no substantial difference in the effective adoption and implementation of enhanced sustainable agricultural methods compared to conventional agriculture practices in Lagos State.

4. Materials and Methods

4.1 Study Area

Lagos, Nigeria, is situated between latitude 6° and 7° N and longitude 2° and 5° E. It is bordered by Ogun State to the north and east, the Benin Republic to the west, and the Atlantic Ocean to the south. Lagos has an area of 356,861 hectares. 47% or 169,613 hectares of land in Lagos are earmarked for agriculture, although only 30% of this land is now being used for agricultural purposes. Lagos State has little arable land and the metropolis of Lagos has a tropical environment (Tajudeen et al., 2022).

The mean annual temperature in Lagos is 27.0 °C, with an average annual rainfall of 1693 mm (Tajudeen et al., 2022). Chukwuma et al., (2021) suggested that Nigeria's 800 km coastline, stretching from Lagos to Calabar, is particularly susceptible to the effects of climate change. The low-lying nature of this coastal area increases its vulnerability to seawater flooding, which can harm inland fisheries and aquaculture by negatively affecting freshwater resources. Lagos state spans 356,861 hectares, with 47% (169,613 hectares) allocated for agriculture, while only 30% of the area is presently used for agricultural purposes (Tajudeen et al., 2022). The city's function as a commercial centre consistently draws business, investment, and companies, resulting in an annual influx of over 1,200 individuals, positioning it as one of the top 10 locations for significant urban migration. Lagos State comprises a geographical area where the state of Lagos spans 37% of it and accommodates over 85% of the people, creating a densely populated administrative region. Lagos is continuously extending its geographic dimensions to accommodate the increasing number of immigrants. Nigeria's population is projected to surpass 400 million by 2050, with around 46% of the population falling between the ages of 18 and 35. This scenario will lead to heightened disparities in necessary skills and educational credentials for a sustainable future, together with a rise in demand for social services and job possibilities, putting strain on existing resources.

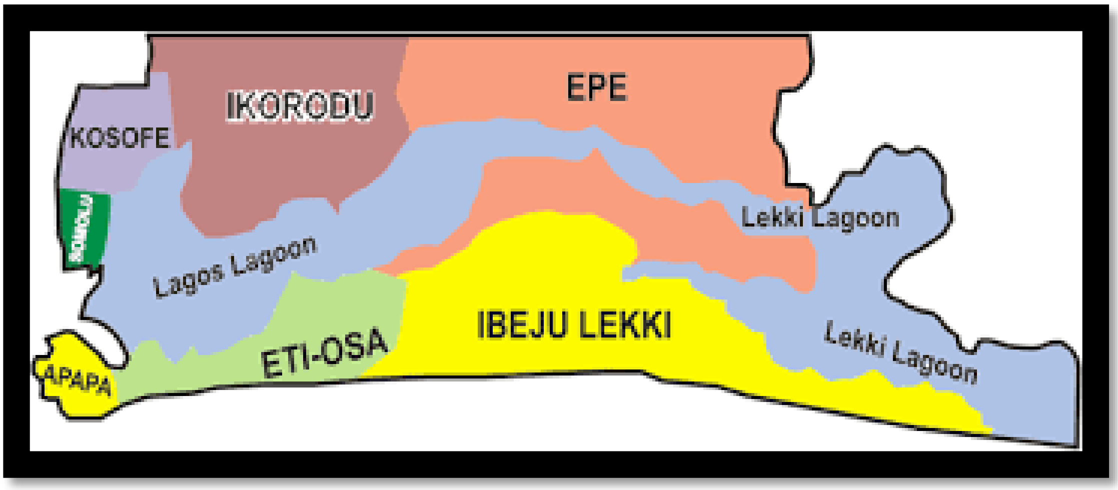

Figure 1: Map of Nigeria showing study areas in Lagos State (Epe, Ibeju lekki, Eti-Osa and Ikorodu)

Source: (Google Maps; Idowu et al., 2020)

4.2 Research Design

Data analysis is categorised into descriptive and exploratory analysis. The former offers a brief overview of the region with a rough-cut, thorough examination, while the latter gives a full and interpretive study of the research topic (Tranfield et al., 2003). Exploratory analysis is crucial for analysing data from the questionnaire to gather information on sustainable agricultural practices in Lagos state, farmers' awareness and perception of these practices, and to compare them with traditional farming practices, as well as their impact on food security.

4.3 Data Collection

The research used primary data collected by questionnaire intended to capture socioeconomic factors, dietary habits, and consumption frequency from rural farming families in Lagos State, Nigeria. The sample for this research was chosen based on the respondent's availability and willingness to participate in the survey. The use of primary data was crucial for the research since it enabled the examination of current events in the area, which would not have been possible with secondary data.

The dietary diversity score assesses the variety and availability of foods in families, serving as a key indicator for food security in rural farming communities. The dietary diversity score (DDS) is the count of food categories ingested during a 24-hour period. The diet was categorised based on nine food groups as advised by FAO. Highly skilled field workers were used for the data collecting procedure

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4.4 Extraction and Synthesis of Data

Information from the surveys was retrieved using Microsoft Excel. Clarity about the data being researched is essential for data extraction and synthesis (Badger et al., 2000).

The data collected was analysed in achieving the objectives of the study using descriptive statistics while ordered logit was used in testing the hypothesis stated for the study. There was also the use of Likert scale for the question that involved the measurement of opinions, attitudes, or behaviours.

4.5 Sampling Procedure and Sample Size

This thesis utilised a multistage sampling approach to identify participants for the research. The first sample method used purposive sampling to pick Lagos State as the research location. The second sample level used stratified sampling to categorise the local government areas in the state into strata or cluster groups, with one stratum selected from the groupings. Simple random selection was used in the last step of sampling to choose 120 individual farms and their families randomly for the research. A representative sample was created by selecting 30 families from each of the four communities (Ikorodu, Epe, Ibeju-Lekki, and Etiosa) chosen for the research.

Table 1a: Multistage Sampling Techniques Used in The Research

STAGES	ACTIVITY	SAMPLING METHOD
1	The research was conducted in Lagos State	Purposive
2	Selection of the local government areas	Stratified
3	Selection of homes within the local government areas	Simple random

4.6 Analytical methods

4.6.1 Descriptive statistics

Descriptive statistics use tables and graphs to summarise data, which may be visually or tabularly represented. The thesis analysed the socioeconomic data by examining factors such as ownership status of farmlands, percentage of produce consumed by farming households, percentage of produce for sale, availability of storage facilities, farm and household characteristics, and the type of farm labour available.

4.6.2 Dietary Diversity Score

Dietary diversity (DD) is the range of food groups consumed within a specific timeframe. This concept suggests that including a variety of foods and food groups in one's diet is beneficial for ensuring the intake of necessary nutrients. Adequate income resources, agrobiodiversity, landscape heterogeneity, and livelihood diversity all contribute to the ability to have a diverse diet and maintain good nutritional health. Additional factors influencing diet and dietary diversity were seasonality, household size, and gender (Kumar and Gautam, 2022; Powell et al., 2017).

The FAO suggested 12 food groups during the Food and Nutrition Technical Assistance (FANTA) project: (A) Cereals & millets (B) White tubers and roots (C) Vegetables (D) Fruits (E) Meat (F) Eggs (G) Fish and other seafood (H) Legumes, nuts, and seeds (I) Milk and milk products (J) Oils and fats (K) Sweets (L) Spices, condiments, and beverages. The metric represents the total of food categories eaten among households over a certain reference period (last day).

The Household Dietary Diversity Score (HDDS) is calculated based on food categories A to L, with a score range of 1 to 12. Households indicated whether they had eaten any of the specified food categories. A "yes" answer was assigned a score of "1" and a "no" response was assigned a score of "0". The scores were added together to get the household DD score, which varies from 0 to 12. This score was categorised as consuming either four or fewer food groups ($DD < 4$) — lower DD, or consuming five or more food groups ($DD \geq 5$) — greater DD, and was used in the next analysis.

4.6.3 Food Consumption Score (FCS)

The Food Consumption Score (FCS) is a food frequency indicator created by the World Food Programme (WFP) to measure both the amount and quality of food consumed by households (Fite et al., 2022). FCS is a combined score derived from dietary variety, food frequency, and the relative nutritional significance of various food categories (Brunner et al., 2002). Research on the association between food intake and dietary behaviours mostly comes from industrialised nations, based on household food consumption scores reported by the head of the family (Fite et al., 2022). Malnutrition dropped from 32.7% to 24.8% during the previous two decades, yet sub-Saharan Africa still maintains the greatest malnutrition rates (Duffy et al., 2009). The food consumption score is determined by the overall intake of oil and sugars, which was common among all participants in the study. The women were categorised based on their food consumption score thresholds: Poor (0 to 28), Borderline (28.5–42), and Acceptable (>42) (Fite et al., 2022). The food items were categorised into food categories, and the total frequencies of all the surveyed food items within each category were calculated. Any total food group frequency value over 7 was noted as 7. The food intake score for each participant was determined by multiplying the frequency of each food type by its weight and then adding these values together to get a composite score.

The FCS is determined by using the algorithm provided by Jones et al. (2013).

$FCS = a1b1 + a2b2 +. a8b8$ ……………………………………………………………(1)

where a represents frequency during a 1-week recall period, 1-8 denotes different food groups, and b indicates the weight of meat, milk, and fish.

The values are as follows: 4 for grains, 3 for pulses, 2 for staples, 1 for vegetables and fruits, and 0.5 for oil and sugar.

4.6.4 Ordered logistic regression

The ordered logit model will be used to analyse the variables that impact dietary variety among farming households. It is a regression model designed for an ordinal response variable. The model operates on the concept that various variables impact individuals in different nutritional diversity groups within the research region. As we transition from one dietary diversity group to another, the influencing factors also change.

To represent such occurrences mathematically:

The equation is $Yi = \beta Xi + U$………………………………………………………...……(2)

Yi represents the observed response for the adult person categorised into high, medium, or low dietary diversity classes. Xi is a collection of autonomous socioeconomic and demographic factors, including age, gender, education level, farm size, and agricultural experience, among others.

The logit model uses a logistic cumulative distribution function for estimation.

The model is then evaluated with the maximum likelihood approach. The empirical model estimated is used to evaluate the variables that influence the dietary variety of agricultural families.

The equation is $P(DD = 1/X) = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \beta 9X9 + \beta 10X10 + \mu i$……………………………………………….…..(3)

The dependent variable P (DD = 1/X) represents the chance that a household's dietary variety depends on a list of independent factors.

Table 1b: Variables Description

Variables	**Description**
Age	The age of the farming household heads
H_{sex}	The sex of the farming household heads in the study area male=1 and 0 otherwise
H_{edu}	The level of education attained by the adult individual or household head

5. Results and Discussion.

5.1 Summary Socio-Economic Characteristics of Farming Households

The socio-economic characteristics of the household examined include age, sex, educational status, household size, farming experience, farm size, and household members working in agriculture.

In Table 2, in terms of the gender of the farmers, 60% of them are males while 40% of them are females. 1.7% of them are less than or equal to 30 years, 22.5% of them are between 31-50 years of age, 36.7% of them are between 41-50 years of age, 29.2% of them are 51-60 years of age, while 10% of them have ages greater than or equal to 60 years. Also in Table 2, 9.2% of the farming households have less than or equal to 3 members in the household, the household size of 50.8% is 4-6 members in the household, 30% have 7-9 members in their households, while 10% have greater than or equal to 10 members in their households. With regards to the number of household members engaged in farming activities, 56.7% had less than or equal to 3 members of their household engaged in farm work, 34.2% had 4-6 members of their household engaged in farming activities, while 9.2% had 7-9 members of their household engaged in farming activities.

The type or level of education of the farmers was also accounted for in Table 2, 10.8% of them are illiterate, 13.3% had elementary to less than high school, and 48.3% of them had their education up until the high school level. 10% of them had up to two years of college education, and 17.5% had a university education and above. 90.8% of the participants had farming or agriculture as their main occupation, while 9.2% did not have agriculture as their main occupation. With respect to farming years, 47.5% of the respondents have been into farming for less than or equal to 10 years, 23.3% have been into farming for 11-20 years, 18.3% have been into farming for 21-30 years, 8.3% of the respondents have been farming for 31-40 years, while 2.5% have been farming for greater than or equals to 41 years. In terms of farm size, 53.3% of the respondents have less than or equal to 1 ha of farmland, 42.5% have 1-5 ha of farmland, and 4.2% have greater than or equal to 6 ha of farmland. 62.7% of the farmers saw an increase in their production, in this group; 30% had an increase in production, 32.5% had an increase in the size of their farmland, and 37.5% had no increase in their farm production.

Table 2: Distribution of farming households by age, gender, education, number of farming years, main occupation, household size and size of farmlands

Variables	**Frequencies**	**Percentage**
Gender		
Male	72	60.0
Female	48	40.0
Total	120	100.0
Age		
<=30	2	1.7
31-50	27	22.5
41-50	44	36.7
51-60	35	29.2
>60	12	10.0
Total	120	100.0
HH Size		
<=3	11	9.2
4-6	61	50.8
7-9	36	30.0
>=10	12	10.0
Total	120	100.0
Education Level		
Illiterate	13	10.8
Elementary To Less Than High School	16	13.3
High School	47	39.2

Two Years of College	12	10.0
University or above	32	26.7
Total	120	100.0
Agric As Main Occupation		
Yes	109	90.8
No	11	9.2
Total	120	100.0
Number Farming Years		
<=10	57	47.5
11-20	28	23.3
21-30	22	18.3
31-40	10	8.3
>=41	3	2.5
Total	120	100.0
Farm Size (Ha)		
<=1	64	53.3
1-5	51	42.5
>=6	5	4.2
Total	**120**	**100.0**

In Table 3, there is also the level of family consumption of agricultural produce, by the farming household. It can be shown that 85% of the farming households consumed greater than or equal to 30% of the produce made, 12.5% consumed 31-50% of the produce, 1.7% consumed 51-70% and 0.8% consumed greater than 70%. It can be inferred that the majority of the households do not consume the produce, and most of the produce is used for other purposes. It can also be seen from Table 3, that a sizable chunk of about 65% of the farming households sells greater than or equal to 70% of their produce, 31-50% sell 4.2% of their produce, and 40% sell 51-70% of their produce. In Table 2, there is also the breakdown of how these farmers sell their produce, and there are four categories of means of sale of the agricultural products. Some of the farmers sell their produce in the local market, some are sold on the spot market, and some are sold to consumers and retailers. 19% of the participants sell less than or equal to 30% of their produce in the local market, 31-50% of produce is sold by 10.8% of the participants at the local market, 51-70% of the produce was sold by 35.8% of the participants. At the spot market, less than or equal to 30% of the produce is sold at the spot market by 62.5% of the participants, 31-50% of the produce is sold at the spot market by 14.2% of the participants, 51-70% of the produce is sold at the spot market by 14.4% and greater than 70% of the produce is sold by 10% of the participants at the spot market. 54.2% of the farming households sell out their produce of less than or equals to 30% to consumers, 15.8% of the farming households sell out their produce of 31-50% to consumers, 17.5% of the farming households sell their produce of 51-70% to consumers, while 12.5% of the farming households sell their produce of greater than 70% of their produce to consumers. Also, in Table 3, 22.5% of the farming households sell their produce out to traders, that will resell the 24.2% of the farming households sell 31-50% to traders who may be wholesalers or retailers, 29.2% of the farming households sell their produce of 51-70% to their consumers. 24.2% of the farming household sell their produce out to traders, which is about greater than or equal to 70% of their produce.

Table 3: Distribution of the farming households by consumption, sales and the means of sale of the produce.

Variables	Frequencies	Percentage
%FAMILY CONSUMPTION		
<=30%	102	85.0
31-50%	15	12.5
51-70%	2	1.7
>70	1	.8
Total	120	100.0

Variables	Frequencies	Percentage
%SALE		
<=30%	2	1.7
31-50%	5	4.2
51-70%	48	40.0
>=70%	65	54.2
Total	120	100.0
%LOCAL MKT(Sales)		
<=30%	23	19.2
31-50%	13	10.8
51-70%	43	35.8
>70%	41	34.2
Total	120	100.0
%SPOT MKT(Sales)		
<=30%	75	62.5
31-50%	17	14.2
51-70%	16	13.3

>70%	12	10.0
Total	120	100.0
CONSUMERS(Sales)		
<=30%	65	54.2
31-50%	19	15.8
51-70%	21	17.5
>=70%	15	12.5
Total	120	100.0
TRADERS		
<=30%	27	22.5
31-50%	29	24.2
51-70%	35	29.2
>70%	29	24.2
Total	120	100.0

Table 4 shows the size of the farms of the participants, what proportion or percentage is owned and which is rented. 39.2% are landowners, while 60.8% have the lands rented out to them by others. This may affect the rate of adoption of sustainable agricultural practices Also in Table 4, 66.7% of the farming households have a short-term contract regarding the sale of their produce with their buyers of less than or equal to 30%, 31-50% of the produce are sold by a short-term contract by 33.3% of the farming households. Conversely, 60.8% of the farming households have a long-term contract with buyers to purchase less than or equal to 30% of their produce, while only 39.2% sell 31-50% of the produce by long-term contract. In Table 4, 63.3% of the farming households preserve their produce by various storage methods which may include storage, refrigerator, sun drying etc., while 36.7% of the farming households do not store their farm produce. Meanwhile, 23.3% of the farmers have collective-owned projects, while 76.6% of them do not have collective-owned projects. 23.3% of them that said that they have collective-owned projects, specified that these projects were owned in cooperative societies. 52.5% of the farmers have non-family employees working with them, while 47.5% do not have non-family employees working with them. It was further specified that 35% of them had less than or equal to 3 non-family employees working with them, 15% of them had 4-6 non-family employees working with them, while 2.5% had greater than or equal to 10 non-family employees working with them. In Table 4, there was also the expectation the farmers had regarding their business, 11.7% plan to continue with their business as usual, a large proportion (60.8%) plan to expand their farm, 1.7% plan to sell or rent for agricultural purposes, while 23.3% plan to get organically certified.

Table 4: Distribution of the farming households by contract terms, farm expectation, storage means, collective-owned projects

Variables	Frequencies	Percentage
%SHORT-TERM CONTRACT		
<=30%	80	66.7
31-50%	40	33.3
Total	120	100.0
%LONG-TERM CONTRACT		
<=30%	73	60.8
31-50%	47	39.2
Total	120	100.0
STORAGE MEANS		
Yes (store, refrigerator, sun drying)	76	63.3
No storage	44	36.7
Total	120	100.0
COLLECTIVE-OWN PROJECTS		
Yes	28	23.3
No	92	76.7
Total	120	100.0
FARM EXPECTATIONS		
Continue with business as usual	14	11.7
Expand farm business	73	60.8

Sell/rent for agricultural purposes	2	1.7
Get organically certified	28	23.3
Get other certification	3	2.5

Table 5, shows the type of sustainable agricultural practices engaged in by the farmers, and the year they first started these practices. 51.7% of the farmers practice organic farming, while 48.3% of them do not practice organic farming. 90% of the farmers practice intercropping while 10% of the farmers do not. 3.3% of them first practised intercropping in 2004-2009, 10.8% of them first practised intercropping in 2010-2014, 33.3% of them first practised intercropping in 2015-2019 and 42.5% first practised intercropping in 2020-2023.

Concerning farming practices, 70% of the farmers practice crop rotation, while 30% of them do not. 5% of them first practised crop rotation from 2010-2014, 6.7% of them first practiced crop rotation from 2015-2019 and 58.3% of them from 2020-2023. 46.7% of the farmers practice cover cropping method of sustainable agricultural practices, 53.3% of them do not practice this method. 1.7% of them first practised cover cropping from 2010-2014, 10% of them first practiced cover cropping from 2015-2019, and 35% of them first practiced from 2020-2023. 44.2% of the farmers practice reduced tillage, while 55.8% of the farmers that were surveyed do not practice reduced tillage. 2.5% of them first practiced reduced tillage from 2015-2019, and 41.7% of them first practiced reduced tillage from 2020-2023. 72.5% of the farmers practice mechanical weeding while 27.5% of them do not. Of the 72.5% that practice mechanical weeding, 45% first practiced in 2015-2019, and 27.5% in 2020-2023. 12.5% of the farmers use synthetic fertilizers on their farmlands, and of this; 2.5% practiced this first in 2015-2019, while the remaining 10%, first practiced this method in 2020-2023, and 87.5% of the farmers do not use synthetic fertilizer on their farmlands. 59.2% of the farmers use organic fertilizer, and of this; 5% first practiced in 2010-2014, 25.8% in 2015-2019, 28.3% in 2020-2023, while 40.8% of the farmers do not use organic fertilizer at all. 54.2% of the farmers use chemical pesticide treatment, 45.8% of them do not use chemical pesticide treatment, of the 54.2% that use chemical pesticides, 1.7% of them first practiced this method from 2010-2014, 33.3% of them first practiced this method from 2015-2019, and 19.2% of them from 2020-

2023. 55.8% of the farmers use non-chemical pest control, and of this; 1.7% first practiced this method from 2010-2014, 6.7% from 2015-2019, 47.5% from 2020-2023, while 55.8% of them do not use non-chemical pest control. 45.8% of the farmers use non-chemical herbicides, and of this, 5.8% first practiced this method from 2010-2014, 15% first practiced this method from 2015-2019, and 25% from 2020-2023, while 54.2% of the farmers do not practice non-chemical herbicide use at all.

Table 5: Distribution of farming households by the type of sustainable agriculture practice adopted and the year of adoption.

Variables	Frequencies	Percentage
ORGANIC FARMING		
YES	62	51.7
NO	58	48.3
Total	120	100.0
INTERCROPPING		
YES	108	90.0
NO	12	10.0
Total	120	100.0
1ST PRACTISED		
2004-2009	4	3.3
2010-2014	13	10.8
2015-2019	40	33.3
2020-2023	51	42.5
Total	108	90.0
CROP ROTATION		
YES	84	70.0
NO	36	30.0
Total	120	100.0
1ST PRACTISED		

2010-2014	6	5.0
2015-2019	8	6.7
2020-2023	70	58.3
Total	84	70.0
COVER CROPPING		
YES	56	46.7
NO	64	53.3
Total	120	100.0
1ST PRACTISED		
2010-2014	2	1.7
2015-2019	12	10.0
2020-2023	42	35.0
Total	56	46.7
REDUCED TILLAGE		
YES	53	44.2
NO	67	55.8
Total	120	100.0
1ST PRACTISED		
2015-2019	3	2.5
2020-2023	50	41.7
Total	53	44.2
MECHANICAL WEEDING		
YES	87	72.5
NO	33	27.5
Total	120	100.0
1ST PRACTISED		
2015-2019	54	45.0
2020-2023	33	27.5
Total	87	72.5

SYNTHETIC FERTILIZER		
YES	15	12.5
NO	105	87.5
Total	120	100.0
1ST PRACTISED		
2015-2019	3	2.5
2020-2023	12	10.0
Total	15	12.5
ORGANIC FERTILIZER		
YES	71	59.2
NO	49	40.8
Total	120	100.0
1ST PRACTISED		
2010-2014	6	5.0
2015-2019	31	25.8
2020-2023	34	28.3
Total	71	59.2
CHEM PESTICIDE TREATMENT		
YES	65	54.2
NO	55	45.8
Total	120	100.0
1ST PRACTISED		
2010-2014	2	1.7
2015-2019	40	33.3
2020-2023	23	19.2
Total	65	54.2
NON-CHEM PEST CONTROL		
YES	67	55.8
NO	53	44.2

Total	120	100.0
1ST PRACTISED		
2010-2014	2	1.7
2015-2019	8	6.7
2020-2023	57	47.5
Total	67	55.8
CHEM HERBICIDE		
YES	55	45.8
NO	65	54.2
Total	120	100.0
1ST PRACTISED		
2010-2014	7	5.8
2015-2019	18	15.0
2020-2023	30	25.0
Total	55	45.8

5.2 Food consumption score

The food consumption score classification of the rural farming households is shown in Table 6. The FCS classify households into one of the following categories: poor (< 21.5), borderline (21.5- 35) and acceptable (> 35). Based on the results it was observed that the majority of the farming households fall within the poor category 48.3%, while only 25% of them fall within the acceptable category. The interpretation of this is that the majority of the households are tethering on the edge and may descend into the borderline category if immediate interventions are not carried out, and this shows that the majority of the households are not food secure entirely. This means that the majority of these households are doing just barely enough to meet their consumption needs and any fluctuation in their income or production could lead them to fall into the poor category.

Table 6: Food Consumption Score of the Rural Farming Households

	Frequencies	Percentage
POOR	58	48.3
BORDERLINE	32	26.7
ACCEPTABLE	30	25.0
Total	120	100.0

5.3 Household dietary diversity score distribution of the rural farming household

According to the number of food types ingested during the study's reference period of seven days—the household's dietary variety score divides it into three major groups. High dietary diversity (those who consumed more than six food groups during the reference period), medium dietary diversity (those who consumed between four and five food groups during the reference period), and low dietary diversity (those who consumed at most three food groups during the reference period) are the three main groups. From Table 7, it was observed that 28.3% of the participants consumed up to three food groups (low dietary diversity) and 71.7 % of participants consumed seven or more food groups (high dietary diversity) in their diet during the preceding 7 days.

This means that most rural farmers can say they have a diverse diet. However, this is not surprising, as dietary diversity means having the right combination of food, but the volume of these foods consumed by rural households is another problem that may have to be addressed to ensure that their dietary diversity corresponds to the consumption of sufficient nutrients in terms of the volume and quality of food consumed by rural agricultural households. This claim is supported by Taruvinga et al.'s conclusions. In 2013, it was found that 29.3% of rural households in developing countries had low dietary diversity, 35.9% had medium dietary diversity, and 34.8% had high dietary diversity (Turvinga, 2013).

Table 7: Distribution of rural farm households by household dietary diversity guideline

	Frequencies	Percentage
Low DDS	34	28.3
High DDS	86	71.7
Total	120	100.0

Table 8: Ordered logistic regression analysis for factors influencing adoption of Sustainable agricultural practice (N= 120)

	Age	HH Size 1	HH Size 2	HH Size 3	Edu Level 2	Edu Level 4	Farm Years 1	Farm Years 2	Farm Years 3	Farm Years 4	Land Own	Organic Fertilizer
B	2.755	2.186	2.093	3.339	-2.160	-2.508	-.843	-.454	-.656	-4.499	-1.248	1.120
Std. Error	1.875	1.204	1.181	1.609	1.142	1.294	.690	.792	1.090	2.313	.582	.652
Sig.	.142	0.070	0.076	0.038	0.059	0.053	0.222	0.567	0.547	0.052	0.032	0.086

The analysis conducted using ordered logistic regression reveals that the age of the head of the rural farming household plays a crucial role (P<0.05) in determining the status of dietary diversity within the specific study area. This is attributable to the fact that age brings about a wealth of experience, and over time, the head of the farming household would have acquired extensive knowledge regarding the nutritional values of food and its significance in promoting overall well-being. As asserted by Demeke et al. (2017), advancing age equips the farming household head with invaluable experiences in dealing with matters about dietary diversity. Through the accumulation of experience that accompanies ageing, they gain a better understanding of effective strategies to mitigate issues and guarantee a diverse and balanced diet.

The variable for farm size is positive and significant at 5% as a factor influencing dietary diversity. This means that as farm size increases, the likelihood of having diverse diet increases This may be a result of the ability to produce more food which the farm size infers on the farming households as the farm size increases, they tend to have the capacity to produce different types of food crops which are important to the household meeting their basic dietary needs. The results show that the gender variable has significant coefficients. The results appear to suggest that women are more likely to use sustainable farming practices as found by (Setsoafia, 2022). Better education enables farmers to be aware of the benefits of SAPs and motivates them to adopt them, especially productivity-enhancing technologies such as improved seed and fertilizer. This finding is consistent with the findings of (Kassie et al., 2013a) for Tanzania and (Gebremariam, 2016d) for Ghana. The significant coefficients of household size suggest that larger households are more likely to adopt multiple SAPs. Larger households usually mean better labour endowments, allowing them to adopt multiple SAPs more easily than small ones. This is consistent with the findings of (Kassie et al., 2013b).

From Table 7, it was observed that 28.3% of the participants consumed up to three food groups (low dietary diversity) and 71.7 % of participants consumed seven or more food groups (high dietary diversity) in their diet during the preceding 7 days.

This means that most rural farmers can say they have a diverse diet. However, this is not surprising, as dietary diversity means having the right combination of food, but the volume of these foods consumed by rural households is another problem that may have to be addressed to ensure that their dietary diversity corresponds to the consumption of sufficient nutrients in terms of the volume and quality of food consumed by rural agricultural households. This claim is supported by Taruvinga et al.'s conclusions. In 2013, it was found that 29.3% of rural households in developing countries had low dietary diversity, 35.9% had medium dietary diversity, and 34.8% had high dietary diversity (Turvinga, 2013).

6. Conclusion and Recommendations

This is a study done to address the adoption of sustainable agricultural practices by farming households in Lagos state, in communities in four local government areas and the influence of these practices on the measure of food security. It was observed from the study that variables such as the age of the farmer, gender, the size of the household and level of education of the farmer, affected the rate of adoption of the earlier practices, and conversely affected their level of production in terms of a significant increase or decrease which is turn an indices of food security.

It was also important to point out that another measure used to analyse the level of food security was the food consumption index and this showed that the majority of the communities where the study was carried out had individuals along the poor category of dietary consumption.

Here are a few recommendations that may be useful for further research in line with the findings of this topic:

1. The government should intensify its efforts to ensure that more agricultural extension programs are carried out to reach these farmers, to enhance the rate of adoption of sustainable agricultural practices
2. Further research should explore the area of making a comparison between previously established traditional farming methods and sustainable agricultural practices, to the income of the farmers and the effect or impact this has on food security.
3. In line with the findings of this research more work needs to be done on improving the wellbeing and quality of life of members of rural farming households.

7. References

Abdulai, A., 2018. Simon Brand Memorial Address: The challenges and adaptation to climate change by farmers in Sub-Saharan Africa. Agrekon 57, 28–39. https://doi.org/10.1080/03031853.2018.1440246

Abdulai, A., Huffman, W., n.d. The Adoption and Impact of Soil and Water Conservation Technology: An Endogenous Switching Regression Application.

Adedokun, A.S., Lawal, B.A., Associate, S., Cooper, P., 2018. Sustainable Agricultural Practices And Arable Farmers Productivity In Lagos State, Nigeria. Journal of Sustainable Development in Africa 20.

Adenle, A.A., Wedig, K., Azadi, H., 2019. Sustainable agriculture and food security in Africa: The role of innovative technologies and international organizations. Technol Soc 58. https://doi.org/10.1016/j.techsoc.2019.05.007

Adeyeye, S.A.O., Ashaolu, T.J., Bolaji, O.T., Abegunde, T.A., Omoyajowo, A.O., 2023. Africa and the Nexus of poverty, malnutrition and diseases. Crit Rev Food Sci Nutr 63, 641–656. https://doi.org/10.1080/10408398.2021.1952160

Ajayi, O.C., 2007. User acceptability of sustainable soil fertility technologies: Lessons from farmers' knowledge, attitude and practice in Southern Africa. Journal of Sustainable Agriculture 30, 21–40. https://doi.org/10.1300/J064v30n03_04

Akukwe, T.I., 2020. Household food security and its determinants in agrarian communities of southeastern Nigeria. Agro-Science 19, 54. https://doi.org/10.4314/as.v19i1.9

Antwi-Agyei, P., Fraser, E.D.G., Dougill, A.J., Stringer, L.C., Simelton, E., 2012. Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. Applied Geography 32, 324–334. https://doi.org/10.1016/j.apgeog.2011.06.010

Armah, R.N.A., Al-Hassan, R.M., Kuwornu, J.K.M., Osei-Owusu, Y., 2013. What Influences Farmers' Choice of Indigenous Adaptation Strategies for Agrobiodiversity Loss in Northern Ghana?, Research Article British Journal of Applied Science & Technology.

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S., Cattaneo, A., 2014. Adoption and intensity of adoption of conservation farming practices in Zambia. Agric Ecosyst Environ 187, 72–86. https://doi.org/10.1016/J.AGEE.2013.08.017

Atosina Akuriba, M., Abunga Akudugu, M., Alhassan, A.-R., 2021. Agribusiness Models for Tackling Poverty, in: Atosina Akuriba, M., Abunga Akudugu, M., Alhassan, A.-R. (Eds.), Agribusiness for Economic Growth in Africa: Practical Models for Tackling Poverty. Springer International Publishing, Cham, pp. 139–159. https://doi.org/10.1007/978-3-030-88759-9_9

Bazzana, D., Gilioli, G., Simane, B., Zaitchik, B., 2021. Analyzing constraints in the water-energy-food nexus: The case of eucalyptus plantation in Ethiopia. Ecological Economics 180. https://doi.org/10.1016/j.ecolecon.2020.106875

Beluhova-Uzunova, R., Atanasov, D., 2019. BIODYNAMIC AGRICULTURE – OLD TRADITIONS AND MODERN PRACTICES. Trakia Journal of Sciences 17, 530–536. https://doi.org/10.15547/tjs.2019.s.01.084

Berry, E.M., Dernini, S., Burlingame, B., Meybeck, A., Conforti, P., 2015. Food security and sustainability: Can one exist without the other? Public Health Nutr. https://doi.org/10.1017/S136898001500021X

Branca, G., Mccarthy, N., Lipper, L., Jolejole, M.C., 2011. Climate Smart Agriculture: A Synthesis of Empirical Evidence of Food Security and Mitigation Benefits from Improved Cropland Management.

Brunner, E.J., Hemingway, H., Walker, B.R., Page, M., Clarke, P., Juneja, M., Shipley, M.J., Kumari, M., Andrew, R., Seckl, J.R., Papadopoulos, A., Checkley, S., Rumley, A., Lowe, G.D.O., Stansfeld, S.A., Marmot, M.G., 2002. Adrenocortical, autonomic, and inflammatory causes of the metabolic syndrome: Nested case-control study. Circulation 106, 2659–2665. https://doi.org/10.1161/01.CIR.0000038364.26310.BD

Carletto, C., Zezza, A., Banerjee, R., 2013. Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. Glob Food Sec. https://doi.org/10.1016/j.gfs.2012.11.006

Carrión Yaguana, V., Alwang, J., Norton, G., Barrera, V., 2016. Does IPM Have Staying Power? Revisiting a Potato-producing Area Years After Formal Training Ended. J Agric Econ 67, 308–323. https://doi.org/10.1111/1477-9552.12140

Charles, H., Godfray, J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M., Toulmin, C., n.d. Food Security: The Challenge of Feeding 9 Billion People.

Charles, H., Godfray, J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M., Toulmin, C., n.d. Food Security: The Challenge of Feeding 9 Billion People.

Charles, N., Rashid, H., James, C., 2014a. Analysis of determinants of farm-level adaptation measures to climate change in Southern Africa. J Dev Agric Econ 6, 232–241. https://doi.org/10.5897/jdae12.0441

Charles, N., Rashid, H., James, C., 2014b. Analysis of determinants of farm-level adaptation measures to climate change in Southern Africa. J Dev Agric Econ 6, 232–241. https://doi.org/10.5897/jdae12.0441

Cheema, A.R., Abbas, Z., n.d. Determinants of Food Insecurity in Pakistan: Evidence from PSLM 2010-11.

Chowdhury, R.B., Moore, G.A., Weatherley, A.J., Arora, M., 2017. Key sustainability challenges for the global phosphorus resource, their implications for global food security, and options for mitigation. J Clean Prod 140, 945–963. https://doi.org/10.1016/J.JCLEPRO.2016.07.012

Chukwuma, E.C., Okonkwo, C.C., Ojediran, J.O., Anizoba, D.C., Ubah, J.I., Nwachukwu, C.P., 2021. A Gis Based Flood Vulnerability Modelling Of Anambra State Using An Integrated Ivfrn-Dematel-Anp Model. Heliyon 7. https://doi.org/10.1016/j.heliyon.2021.e08048

Debela, N., Mohammed, C., Bridle, K., Corkrey, R., McNeil, D., 2015. Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia. Springerplus 4. https://doi.org/10.1186/s40064-015-1012-9

Dhanarajan, A., 2017. Sustainable agriculture towards food security, Sustainable Agriculture towards Food Security. Springer Singapore. https://doi.org/10.1007/978-981-10-6647-4

Dhiman, V., 2020. Organic Farming for Sustainable Environment: Review of Existed Policies and Suggestions for Improvement. International Journal of Research and Review (ijrrjournal.com) 7, 22.

Dirzo, R., Raven, P.H., 2003. Global state of biodiversity and loss. Annu Rev Environ Resour 28, 137–167. https://doi.org/10.1146/annurev.energy.28.050302.105532

Drammeh, W., Hamid, N.A., Rohana, A.J., 2019. Determinants of household food insecurity and its association with child malnutrition in Sub-Saharan Africa: A review of the literature. Current Research in Nutrition and Food Science 7, 610–623. https://doi.org/10.12944/CRNFSJ.7.3.02

Duffy, P., Zizza, C., Jacoby, J., Tayie, F.A., 2009. Diet Quality is Low among Female Food Pantry Clients in Eastern Alabama. J Nutr Educ Behav 41, 414–419. https://doi.org/10.1016/j.jneb.2008.09.002

Ehiakpor, D.S., Danso-Abbeam, G., Mubashiru, Y., 2021. Adoption of interrelated sustainable agricultural practices among smallholder farmers in Ghana. Land use policy 101. https://doi.org/10.1016/j.landusepol.2020.105142

Fikire, A.H., Zegeye, M.B., 2022. Determinants of Rural Household Food Security Status in North Shewa Zone, Amhara Region, Ethiopia. Scientific World Journal 2022. https://doi.org/10.1155/2022/9561063

Firdaus, R.B.R., Leong Tan, M., Rahmat, S.R., Senevi Gunaratne, M., 2020. Paddy, rice and food security in Malaysia: A review of climate change impacts. Cogent Soc Sci. https://doi.org/10.1080/23311886.2020.1818373

Fite, M.B., Tura, A.K., Yadeta, T.A., Oljira, L., Roba, K.T., 2022. Factors associated with food consumption score among pregnant women in Eastern Ethiopia: a community-based study. J Health Popul Nutr 41. https://doi.org/10.1186/s41043-022-00286-x

Gebremariam, G., 2016a. Give to AgEcon Search.

Gebremariam, G., 2016b. Give to AgEcon Search.

Gebremariam, G., 2016c. Give to AgEcon Search.

Gebremariam, G., 2016d. Give to AgEcon Search.

Ghimire, R., Huang, W.C., Shrestha, R.B., 2015. Factors Affecting Adoption of Improved Rice Varieties among Rural Farm Households in Central Nepal. Rice Sci 22, 35–43. https://doi.org/10.1016/J.RSCI.2015.05.006

Gomiero, T., 2016. Soil degradation, land scarcity and food security: Reviewing a complex challenge. Sustainability (Switzerland). https://doi.org/10.3390/su8030281

Habicht, J., Pelletier, D.L., Guthrie, H.A., Martin, R.J., Meyers, L.D., Olson, J.A., Woteki, C.E., Allison, R.G., Olson, A., n.d. The Importance of Context in Choosing Nutritional Indicators12 151?

Hamadina, M.K., Hamadina, E.I., 2015. Smallholder Farmers and Sustainability Issues: The Case of Fadama III Sub-Projects in Bayelsa State of Nigeria 2.

Hanjra, M.A., Qureshi, M.E., 2010. Global water crisis and future food security in an era of climate change. Food Policy 35, 365–377. https://doi.org/10.1016/j.foodpol.2010.05.006

Hoddinott, J., 1999. Choosing Outcome Indicators of Household Food Security.

Idowu, E.T., Waswa, M.R., Lasisi, K.H., Mubea, K., Nyadawa, M., Kiema-Kyalo, B.J., 2020. Towards Sustainability of Coastal Environments: Urban Growth Analysis and Prediction of Lagos, State Nigeria.

Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F., Mekuria, M., 2013a. Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. Technol Forecast Soc Change 80, 525–540. https://doi.org/10.1016/j.techfore.2012.08.007

Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F., Mekuria, M., 2013b. Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. Technol Forecast Soc Change 80, 525–540. https://doi.org/10.1016/j.techfore.2012.08.007

Kassie, M., Marenya, P., Tessema, Y., Jaleta, M., Zeng, D., Erenstein, O., Rahut, D., 2018a. Measuring Farm and Market Level Economic Impacts of Improved Maize

Production Technologies in Ethiopia: Evidence from Panel Data. J Agric Econ 69, 76–95. https://doi.org/10.1111/1477-9552.12221

Kassie, M., Marenya, P., Tessema, Y., Jaleta, M., Zeng, D., Erenstein, O., Rahut, D., 2018b. Measuring Farm and Market Level Economic Impacts of Improved Maize Production Technologies in Ethiopia: Evidence from Panel Data. J Agric Econ 69, 76–95. https://doi.org/10.1111/1477-9552.12221

Kassie, M., Teklewold, H., Jaleta, M., Marenya, P., Erenstein, O., 2015. Understanding the adoption of a portfolio of sustainable intensification practices in eastern and southern Africa. Land use policy 42, 400–411. https://doi.org/10.1016/J.LANDUSEPOL.2014.08.016

Keesstra, S., Nunes, J., Novara, A., Finger, D., Avelar, D., Kalantari, Z., Cerdà, A., 2018. The superior effect of nature based solutions in land management for enhancing ecosystem services. Science of the Total Environment. https://doi.org/10.1016/j.scitotenv.2017.08.077

Kimathi, S.M., Ayuya, O.I., Mutai, B., 2021. Adoption of climate-resilient potato varieties under partial population exposure and its determinants: Case of smallholder farmers in Meru County, Kenya. Cogent Food Agric 7. https://doi.org/10.1080/23311932.2020.1860185

Kotu, B.H., Alene, A., Manyong, V., Hoeschle-Zeledon, I., Larbi, A., 2017. Adoption and impacts of sustainable intensification practices in Ghana. Int J Agric Sustain 15, 539–554. https://doi.org/10.1080/14735903.2017.1369619

Kumar, I., Gautam, M., 2022. Determinants of Dietary Diversity Score for the Rural Households of Uttar Pradesh State. Article in Journal of Food Nutrition and Dietetics. https://doi.org/10.21088/ijfnd.2322.0775.10122.1

Lal, R., 2006. Enhancing crop yields in the developing countries through restoration of the soil organic carbon pool in agricultural lands. Land Degrad Dev 17, 197–209. https://doi.org/10.1002/ldr.696

Leonardo, W., van de Ven, G.W.J., Kanellopoulos, A., Giller, K.E., 2018. Can farming provide a way out of poverty for smallholder farmers in central Mozambique? Agric Syst 165, 240–251. https://doi.org/10.1016/J.AGSY.2018.06.006

Lokosang, L.B., Ramroop, S., Hendriks, S.L., 2011. Establishing a robust technique for monitoring and early warning of food insecurity in post-conflict south Sudan using ordinal logistic regression. Agrekon 50, 101–130. https://doi.org/10.1080/03031853.2011.617902

Lynch, J., Cain, M., Frame, D., Pierrehumbert, R., 2021. Agriculture's Contribution to Climate Change and Role in Mitigation Is Distinct From Predominantly Fossil CO2-Emitting Sectors. Front Sustain Food Syst 4. https://doi.org/10.3389/fsufs.2020.518039

Maja, M.M., Ayano, S.F., 2021. The Impact of Population Growth on Natural Resources and Farmers' Capacity to Adapt to Climate Change in Low-Income Countries. Earth Systems and Environment 5, 271–283. https://doi.org/10.1007/s41748-021-00209-6

Manda, J., Alene, A.D., Gardebroek, C., Kassie, M., Tembo, G., 2016. Adoption and Impacts of Sustainable Agricultural Practices on Maize Yields and Incomes: Evidence from Rural Zambia. J Agric Econ 67, 130–153. https://doi.org/10.1111/1477-9552.12127

Manda, J., Alene, A.D., Tufa, A.H., Abdoulaye, T., Kamara, A.Y., Olufajo, O., Boukar, O., Manyong, V.M., 2020. Adoption and Ex-post Impacts of Improved Cowpea Varieties on Productivity and Net Returns in Nigeria. J Agric Econ 71, 165–183. https://doi.org/10.1111/1477-9552.12331

Martey, E., Etwire, P.M., Kuwornu, J.K.M., 2020. Economic impacts of smallholder farmers' adoption of drought-tolerant maize varieties. Land use policy 94. https://doi.org/10.1016/j.landusepol.2020.104524

Mbow, C., van Noordwijk, M., Prabhu, R., Simons, T., 2014. Knowledge gaps and research needs concerning agroforestry's contribution to Sustainable Development Goals in Africa. Curr Opin Environ Sustain. https://doi.org/10.1016/j.cosust.2013.11.030

McCarthy, N., Kilic, T., Brubaker, J., Murray, S., De La Fuente, A., 2021. Droughts and floods in Malawi: Impacts on crop production and the performance of sustainable land management practices under weather extremes. Environ Dev Econ 26, 432–449. https://doi.org/10.1017/S1355770X20000455

Mgomezulu, W.R., Edriss, A.-K., Machila, K., 2018. Impact of Gliricidia Fertilizer Tree Technology on Smallholder Farmers Economic Livelihood in Malawi: Case of Kasungu District. J Sustain Dev 11, 162. https://doi.org/10.5539/jsd.v11n6p162

Mohammed, A., Wassie, S.B., Teferi, E.T., 2021. Determinants of Smallholders' Food Security Status in Kalu District, Northern Ethiopia. Challenges 12, 17. https://doi.org/10.3390/challe12020017

Moradabadi, S.A., Ziaee, S., Mehrabi Boshrabadi, H., Keikha, A., 2020. Effect of Agricultural Sustainability on Food Security of Rural Households in Iran, J. Agr. Sci. Tech.

Muhie, S.H., 2022. Novel approaches and practices to sustainable agriculture. J Agric Food Res. https://doi.org/10.1016/j.jafr.2022.100446

Murendo, C., Gwara, S., Mpofu, N., Pedzisa, T., Mazvimavi, K., Chivenge, P., 2016. The adoption of a portfolio of sustainable agricultural practices by smallholder farmers in Zimbabwe.

Mwalupaso, G.E., Korotoumou, M., Eshetie, A.M., Essiagnon Alavo, J.P., Tian, X., 2019. Recuperating dynamism in agriculture through adoption of sustainable agricultural technology - Implications for cleaner production. J Clean Prod 232, 639–647. https://doi.org/10.1016/J.JCLEPRO.2019.05.366

Nchanji, E.B., Bellwood-Howard, I., Schareika, N., Chagomoka, T., Schlesinger, J., Axel, D., Rüdiger, G., 2017. Assessing the sustainability of vegetable production practices in northern Ghana*. Int J Agric Sustain 15, 321–337. https://doi.org/10.1080/14735903.2017.1312796

Nkegbe, P.K., Shankar, B., 2014. Adoption intensity of soil and water conservation practices by smallholders: Evidence from northern Ghana. Bio-based and Applied Economics 3, 159–174. https://doi.org/10.13128/BAE-13246

Nkomoki, W., Bavorová, M., Banout, J., 2018. Adoption of sustainable agricultural practices and food security threats: Effects of land tenure in Zambia. Land use policy 78, 532–538. https://doi.org/10.1016/J.LANDUSEPOL.2018.07.021

Obayelu, A.E., 2012. Households' food security status and its determinants in the North-Central Nigeria. Food Economics 9, 241–256. https://doi.org/10.1080/2164828x.2013.845559

Ogundari, K., 2017. Categorizing households into different food security states in Nigeria: the socio-economic and demographic determinants. Agricultural and Food Economics 5. https://doi.org/10.1186/s40100-017-0076-y

Pangaribowo, E.H., Gerber, N., Torero, M., 2013. Food and nutrition security indicators: A review.

Paull, J., Hennig, B., 2020. A World Map of Biodynamic Agriculture. Agricultural and Biological Sciences Journal 6, 114–119.

Pham, H.G., Chuah, S.H., Feeny, S., 2021. Factors affecting the adoption of sustainable agricultural practices: Findings from panel data for Vietnam. Ecological Economics 184, 107000. https://doi.org/10.1016/J.ECOLECON.2021.107000

Pham, H.-G., Nguyen, T.-A.T., 2023. Adoption of Sustainable Practices for Improving Agricultural Productivity in Viet Nam.

Powell, B., Bezner Kerr, R., Young, S.L., Johns, T., 2017. The determinants of dietary diversity and nutrition: Ethnonutrition knowledge of local people in the East Usambara Mountains, Tanzania. J Ethnobiol Ethnomed 13. https://doi.org/10.1186/s13002-017-0150-2

Power, A.G., 2010. Ecosystem services and agriculture: Tradeoffs and synergies. Philosophical Transactions of the Royal Society B: Biological Sciences. https://doi.org/10.1098/rstb.2010.0143

Pretty, J., Benton, T.G., Bharucha, Z.P., Dicks, L. V., Flora, C.B., Godfray, H.C.J., Goulson, D., Hartley, S., Lampkin, N., Morris, C., Pierzynski, G., Prasad, P.V.V., Reganold, J., Rockström, J., Smith, P., Thorne, P., Wratten, S., 2018. Global assessment of agricultural system redesign for sustainable intensification. Nat Sustain 1, 441–446. https://doi.org/10.1038/s41893-018-0114-0

Pretty, J., Bharucha, Z.P., 2014. Sustainable intensification in agricultural systems. Ann Bot. https://doi.org/10.1093/aob/mcu205

Pretty, J.N., Thompson, J., Hinchcliffe, F., 1996. International Institute for Environment and Development Sustainable Agriculture: Impacts on Food Production and Challenges for Food Security, International Institute for Environment and Development.

Rhodes, C.J., 2017. The imperative for regenerative agriculture. Sci Prog. https://doi.org/10.3184/003685017X14876775256165

Runhaar, H., 2016. Tools for integrating environmental objectives into policy and practice: What works where? Environ Impact Assess Rev 59, 1–9. https://doi.org/10.1016/J.EIAR.2016.03.003

S., L., 2022. Agronomic practices in soil water management for sustainable crop production under rain fed agriculture of Drylands in Sub-Sahara Africa. Afr J Agric Res 18, 18–26. https://doi.org/10.5897/ajar2021.15822

Sen, S., Singh, M.K., Das, A., 2021. Effects of Food Production and Consumption on Environment and Climate, in: Mukherjee, M., Mandal, J.K., Bhattacharyya, S., Huck, C., Biswas, S. (Eds.), Advances in Medical Physics and Healthcare Engineering. Springer Singapore, Singapore, pp. 361–370.

Setsoafia, E.D., 2022. The impact of the adoption of sustainable agricultural practices on farm income and household food security in Northern Ghana.

Sharma, A., Shukla, A., Attri, K., Kumar, M., Kumar, P., Suttee, A., Singh, G., Barnwal, R.P., Singla, N., 2020. Global trends in pesticides: A looming threat and viable alternatives. Ecotoxicol Environ Saf 201, 110812. https://doi.org/10.1016/J.ECOENV.2020.110812

Sinha, R.K., Hahn, G., Singh, P.K., Suhane, R.K., Anthonyreddy, A., n.d. Organic Farming by Vermiculture: Producing Safe, Nutritive and Protective Foods by Earthworms (Charles Darwin's Friends of Farmers).

Skaf, L., Buonocore, E., Dumontet, S., Capone, R., Franzese, P.P., 2019. Food security and sustainable agriculture in Lebanon: An environmental accounting framework. J Clean Prod 209, 1025–1032. https://doi.org/10.1016/J.JCLEPRO.2018.10.301

Struik, P.C., Klerkx, L., van Huis, A., Röling, N.G., 2014. Institutional change towards sustainable agriculture in West Africa. Int J Agric Sustain 12, 203–213. https://doi.org/10.1080/14735903.2014.909641

Tajudeen, T.T., Omotayo, A., Ogundele, F.O., Rathbun, L.C., 2022. The Effect of Climate Change on Food Crop Production in Lagos State. Foods 11. https://doi.org/10.3390/foods11243987

Teklewold, H., Kassie, M., Shiferaw, B., 2013a. Adoption of multiple sustainable agricultural practices in rural Ethiopia. J Agric Econ 64, 597–623. https://doi.org/10.1111/1477-9552.12011

Teklewold, H., Kassie, M., Shiferaw, B., Köhlin, G., 2013b. Cropping system diversification, conservation tillage and modern seed adoption in Ethiopia: Impacts on household income, agrochemical use and demand for labor. Ecological Economics 93, 85–93. https://doi.org/10.1016/J.ECOLECON.2013.05.002

Teklewold, H., Kassie, M., Shiferaw, B., Köhlin, G., 2013c. Cropping system diversification, conservation tillage and modern seed adoption in Ethiopia: Impacts on household income, agrochemical use and demand for labor. Ecological Economics 93, 85–93. https://doi.org/10.1016/J.ECOLECON.2013.05.002

Tesfaye, W., Tirivayi, N., 2020. Crop diversity, household welfare and consumption smoothing under risk: Evidence from rural Uganda. World Dev 125. https://doi.org/10.1016/j.worlddev.2019.104686

Thapa Karki, S., Bennett, A.C.T., Mishra, J.L., 2021. Reducing food waste and food insecurity in the UK: The architecture of surplus food distribution supply chain in addressing the sustainable development goals (Goal 2 and Goal 12.3) at a city level. Industrial Marketing Management 93, 563–577. https://doi.org/10.1016/J.INDMARMAN.2020.09.019

Umeh, G.N., Igwe, G.V.C., 2019. Adoption of Sustainable Agricultural Practices among Farmers in Ohaukwu Local Government Area of Ebonyi State, Nigeria.

Verger, E.O., Le Port, A., Borderon, A., Bourbon, G., Moursi, M., Savy, M., Mariotti, F., Martin-Prevel, Y., 2021. Dietary Diversity Indicators and Their Associations with

Dietary Adequacy and Health Outcomes: A Systematic Scoping Review. Advances in Nutrition 12, 1659–1672. https://doi.org/10.1093/ADVANCES/NMAB009

Weerasekara, P.C., Withanachchi, C.R., Ginigaddara, G.A.S., Ploeger, A., 2020. Understanding Dietary Diversity, Dietary Practices and Changes in Food Patterns in Marginalised Societies in Sri Lanka. Foods 9. https://doi.org/10.3390/foods9111659

Weltin, M., Zasada, I., Piorr, A., Debolini, M., Geniaux, G., Moreno Perez, O., Scherer, L., Tudela Marco, L., Schulp, C.J.E., 2018. Conceptualising fields of action for sustainable intensification – A systematic literature review and application to regional case studies. Agric Ecosyst Environ 257, 68–80. https://doi.org/10.1016/J.AGEE.2018.01.023

Wiebe, K., Robinson, S., Cattaneo, A., 2018. Climate Change, Agriculture and Food Security, in: Sustainable Food and Agriculture: An Integrated Approach. Elsevier, pp. 55–74. https://doi.org/10.1016/B978-0-12-812134-4.00004-2

Yu, B., You, L., 2013. A typology of food security in developing countries. China Agricultural Economic Review 5, 118–153. https://doi.org/10.1108/17561371311294810

Zeweld, W., Van Huylenbroeck, G., Tesfay, G., Speelman, S., 2021. Sustainable Agricultural Practices as a Response to Climate Change in Northern Ethiopia, in: Handbook of Climate Change Management: Research, Leadership, Transformation. Springer International Publishing, pp. 1245–1276. https://doi.org/10.1007/978-3-030-57281-5_63

Zhang, W., Jiang, F., Ou, J., 2011. Global pesticide consumption and pollution: with China as a focus, Proceedings of the International Academy of Ecology and Environmental Sciences.

Zhao, W., Yu, K., Tan, S., Zheng, Y., Zhao, A., Wang, P., Zhang, Y., 2017. Dietary diversity scores: An indicator of micronutrient inadequacy instead of obesity for Chinese children. BMC Public Health 17. https://doi.org/10.1186/s12889-017-4381-x

Zilberman, D., Goetz, R., Garrido, A., n.d. Climate Smart Agriculture Building Resilience to Climate Change

8 Appendix

Small-Scale Farmers Survey on Adoption of Sustainable Agricultural Practices in Lagos State, Nigeria and their Influence on Food Security

This survey aims to find out if small-scale farmers in Lagos State, Nigeria.

use sustainable agricultural practices, the level of adoption and influence on food security.

QUESTIONAIRE NUMBER ☐

INTERVIEWEE NAME ____________________________

INTERVIEWER NAME ___________________________

DATE ______________________

LOCAL GOVERNMENT ____________________

VILLAGE NAME ___________________

ARE YOU CERTIFIED ORGANIC FARMER YES ☐ NO ☐

Part 1: TECHNOLOGIES USED IN FARM

This part is to find out which technologies according to IFOAM certification standards you use on your farm.

QUESTION 1.1 Do you currently use the following technologies/practices on your farm? Please fill in the table.

PRACTICES			**IF YES**	**IF YES**	**IF YES**	**IF NO**	**IF NO**
	USAGE		**When first implemented? (Year)**	**Type of crop.** 1. Cereal 2. Fruits 3. Vegetables 4. Legumes 5.Tuber 6. Fodder *(May select more than one)*	**Main objectives** 1. Pest control 2. Weed control 3. Soil protection 4. Profit increase 5. Yield increase 6. Climate change adaptation *(May select more than one)*	**Did you practice in the last 5 years?**	**Main reason** 1. Too costly 2. Too time-consuming 3. Not beneficial 4. Not enough information *(May select more than one)*
	YES	**NO**					
Intercropping [1]							
Crop rotation							
Cover cropping [2]							

Reduced tillage								
Mechanical weeding								
Synthetic fertilizers								
Organic fertilizers								
Chemical pesticides treatment								
Non-chemical control of pests and diseases								
Chemical herbicides								

[1] Intercropping - two or more crops on the same field at the same time.

[2] Cover cropping – one of the plant sis grown for the purpose of soil health or fertility rather than being harvested.

QUESTION 1.2 In case organic fertilizers are applied, please fill the following table, and indicate which kind you use and how often.

	Never	**At least once in 5 years**	**At least once a year**
Animal manure			
Poultry manure			
Green manure [3]			
Compost			

[3] crops cultivated primarily to improve the soil with nutrients and organic

QUESTION 1.3 In case chemical fertilisers are applied, please specify________________

____

QUESTION 1.4 In case non-chemical control of pests and diseases (plant protection) is used, please fill the following table

	Never	**At least once in 5 years**	**At least once a year**
Mechanical ways			
Physical and pheromone traps			
Biological enemies of pests			

QUESTION 1.5 In case that you use chemical herbicides, please specify_________________

____

<u>PART 2: PARTICIPANTS KNOWLEDGE ON FOOD SECURITY</u>

2.1. DIETARY DIVERSITY OF FARMING HOUSEHOLDS

Use the **Household Dietary Diversity Score Table** provided below. You are given a list of 12 food items. Indicate whichever one your household took in the last five days**. If anyone in <u>your household took the food item</u> in the last 24 hours, <u>indicate with (= 1),</u> if <u>nobody took</u> it <u>indicate (= 0).</u>**

No	Food Items and Filters	Responses Yes = 1, No = 0
A	**Any Cereals or local foods** such as corn or maize ,rice, wheat, sorghum, amala, eba, fufu, semo, bread, Rice, Wheat, etc	
B	**Any Food from Roots or Tubers** such as Potatoes, Yam, Cassava etc	
C	**Any Vegetables:** Ewedu, ugwu, waterleaf, amaranthus , okra, tomatoes, moringa, bitter leaf, onion etc.	
D	**Any Fruits:** Oranges, mango, walnut, watermelon, pawpaw, coconut, etc	
E	**Any meat:** Beef, pork, chicken, goat, rabbit, wild game, snake, snails, duck, liver, kidney, heart etc	
F	**Any Eggs:** Eggs from chicken, quail, duck, guinea fowl or any other eggs.	
G	**Any fish or seafood:** Fresh or dried fish or shell fish, frozen fish, Catfish, crayfish, prawns, crab and any other seafood.	
H	**Any food from legumes, nuts and seeds:** Beans, peas, palm kernel nut, groundnut, soybean seeds or other from these (e.g. moi-moi, akara, kunu).	
I	**Any Milk & Milk Products** : Such as evaporated milk, skimmed milk, fresh milk, powdered milk, soybean milk, local cheese (wara),yogurt or other milk products like nunu etc	
J	**Any food from fats & oils** : such as stew, stewed beans, stewed porridge, butter, margarine, bleached palm oil, soybean oil, groundnut oil etc	

K	**Any Sugar, Honey or confectionaries:** sugar cane, sugar, honey, sweetened juice drinks, sugary foods such as chocolates and cakes.	
L	**Any seasonings and beverages:** black pepper, salt, condiments (maggi cube, locust beans, curry leaves and other local spices etc.)Coffee, tea, alcoholic beverages etc.	

QUESTION 2.2. Harvest and Post Harvest Constraints Ranking. Please fill the table and indicate how you agree or disagree with the following statement.

Activity	**Post Harvest Constraints**	**Disagree (1)**	**Somehow disagree (2)**	**Neutral (3)**	**Somehow agree (4)**	**Agree (5)**
Harvesting	- Difficulty in Acquiring equipment - High cost of Labour - Knowledge of modern harvesting methods - Physical loss					
Drying	- Difficulty in Acquiring equipment - Difficulty in Management of equipment - Physical loss of produce					
Storage	- Loss caused by insects - Loss caused by rodents					

	- Difficulty in acquiring storage facilities & equipment					
Transportation	- High cost of transportation - Poor access roads to the market - Distance from farm to market					

Part 3: FARM AND HOUSEHOLDS' ATTRIBUTES

3.1 What is your gender?

Male ☐ Female ☐

3.2. How old are you?

- ☐ ≤30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ ≥60

3.3. Current number of people living in your household:

Men____ Women___

3.4. Apart from you, how many members of your household are involved in farming?

Men ___ Women___

3.5. What is your highest level of education?

- ☐ Less than elementary level (Illiterate)
- ☐ Elementary to less than high school
- ☐ High school
- ☐ Two years of college
- ☐ University or above

3.6. Is agriculture your main occupation?

Yes ☐ No ☐

3.7. For how many years have you been engaged in farming? _______ years

3.8. Do you get any farming advice from fellow farmers?

Yes ☐ No ☐

If yes, please specify ___________

3.9. Do you get any farming advice from government officials?

Yes □ No □

If yes, please specify ___________

3.10. What is your farm size in ha? ___________

3.11. Has your farm increased the size of production the last five (5) years?

Yes □ No □

If yes, please specify ___________

3.12. Please complete the table with farm details:

	Unit (Hectares)
Agricultural land ownership	
Agricultural land rented	
Agricultural land in use of which	
Field vegetable	
Fruit	
Cereal	
Fodder	
Tuber	
Other cultivated	
Uncultivated	

3.13. Please indicate the % of farm production for family consumption vs. market sale:

Personal/Family consumption ____________**%**

Sale on market ____________**%**

3.14. Please indicate the % of produce sold under the contract

At the local market ____________**%**

Spot market ____________**%**

Short-term contract ____________**%**

Long-term contract ____________**%**

Others ____________**%**

3.15. Please indicate the % to whom do sell your products?

Directly to consumers __________**%**

Traders __________**%**

Others __________**%**

3.16. How do you store/keep any crop that you have not sold? __________

3.17. Do you have farmers collectively owned project?

Yes □ No □

If yes, please specify __________

3.18 Do you have employees on your farm who aren't your family members? If yes, how many?

____

3.19 Further farm expectations. What are your plans or intentions within the next 5 years (please tick one box only)

- ☐ I will continue with my current business as usual
- ☐ I will expand my farming business
- ☐ I will sell/rent it for agricultural purposes
- ☐ I plan to get organically certified
- ☐ I plan to get any other certification
- ☐ Other. Please specify __________

Thank you very much for participating in this interview!